PRACTICAL HELPS

FOR TEXTILE MILL MEN

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for

Textile Mill Men

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FOREWORD

The textile picture is changing rapidly. New fibers, new machinery, new processes, are being introduced.

The man in the mill is not interested academically in the new ideas represented by these developments. He is interested in the practical application of those ideas to his every-day job.

That is exactly what this book is designed to offer. It is composed of articles carefully selected from the wealth of practical material on the New Textile Industry, published in *Textile World*.

For convenience, its contents are divided into sections covering the various branches of the textile industry. However, since many articles in any one section contain material which is applicable to the problems of men in other divisions, these have been cross-indexed under functional headings. We recommend use of this index to readers, in order that they may secure the maximum benefit from this book.

"Practical Helps for Textile Mill Men" is offered to our new subscribers in order that they may be in touch with recent developments and be in a position to follow further trends as they are interpreted week by week in *Textile World*.

DOUGLAS G. WOOLF,
Editor.

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Cotton Section

COTTON YARN MILL NOTES

Grinding Cotton Card

By Gilbert R. Merrill

Herewith is begun a new series of short articles on the correct operation of cotton-yarn machinery. The articles are written as brief instructions, tabulated in logical order and expressed in straight-to-the-point language.—*Editor.*

Cleaning the Card

Remove the lap from the feed roll by disengaging the side-shaft bevel gear at the doffer end. Turn the feed roll backwards.

Run the card until all the flats are stripped out; this usually takes toward one hour.

Remove the flat strips from the front of the flat chain.

Remove flyings from under the card, for they may cause fire.

Strip the cylinder and doffer. (See later directions for stripping.)

Take off the main belt.

Hook out the sides of the card between the frame and the cylinder and doffer, getting out all the collected cotton. Use a specially shaped hook, commonly made from a bale hoop.

Clean and oil the coiler.

Preparing for Grinding

Remove main belt guide.

Take off the doffer driving belt and disengage the doffer driving gear.

Disengage the calender-roll drive, putting a weight on the handle to prevent re-engaging, or remove the large doffer gear from the doffer shaft.

Remove the belt from the cylinder to the licker-in.

Remove the doffer-comb bands.

Replace the cylinder belt with one to drive the cylinder backwards, so that the main cylinder turns over the top from the front to the back.

Connect the cylinder and doffer pulleys with an open belt.

Start the card, carefully. (The card is now so arranged that the cylinder, doffer, and flats are the only parts that are moving. The cylinder runs at normal speed but backward, while the doffer runs at a much higher speed than normal but in the normal direction.)

Brush out the cylinder and doffer very carefully. Use a brush about 20 in. long and 2 in. wide, with stiff bristles about 1 in. long. Hold this firmly and press it into the wire of the moving cylinder and doffer.

Stop the card.

Lift bent or jammed wire with a special hook. The point of the wire should be lifted just higher than the surrounding wire so that it may be ground to the level of the rest of the wire.

Setting the Grinding Rolls

Put on the grinding rolls with the pulleys on the opposite side of the card from the main pulley and set them far enough from the clothing so that a thick card gauge can go between the emery and the cloth.

Put on the grinding band to drive the grinding rolls so that they turn in the same direction as the cylinder and the doffer. This causes the surface of the emery-covered role to run against the back of the card wire.

Start the card running, listening for contacts. If either roll touches, it will cause a brushing sound, the intensity of which depends on the contact.

Set the rolls down gradually until a slight brushing action is heard. There should not be a shower of sparks, but there should be one occasionally, when the roll is set properly. Set the cylinder grinding roll first. Never really loosen the nuts, just back off a little on one nut and take up what is possible on the nut opposite, letting one end down a little and then the other end. Do not let a roll down too much on one end without letting the other end down in proportion. When the slightest brushing is heard at one end, let the other end down until it brushes also.

Instructions for Piecing Up a Roving Frame

(Note: Before piecing up any end pull off any singles or doubles due to an end broken out or an extra end running in. If this reduces the size of the bobbin too much, take it off and break out the roving at the back rolls, or find a bobbin of the proper size.)

1. Stop the frame, bringing the flyer pressers a little to the ight of the extreme back position and so that the front and ack flyers are in line.
2. Collect any roving on the roll beam, leaving a short fringe rojecting from the front rolls. (Pocket the roving.)
3. Lift the bobbin enough to free it and unwind a little more ıan enough roving to reach to the front roll. Replace the obbin firmly on the dog.
4. Twist this slightly by rolling it between the palms to give twist which spirals upward to the right.
5. Using roving as near the bobbin as possible, thread the id through the hollow flyer leg, starting at the top.
6. Wrap the end twice around the presser arm and put it ırough the presser eye.
7. Draw the end up until tight.
8. Carry the end around the back of the top of the flyer nd thread it through the hole on the right front and up ırough the hole in the top.
9. Carry the end to the projecting fringe of fibers at the ront roll.
10. Break off any extra length, but leave a little slack etween the front rolls and the flyer.
11. Twist the roving into the fringe of fibers, starting at the ight, rolling it over the top to the left with the thumb and orefinger.
12. Take up any excess slack between the bobbin and the ront rolls by lifting and turning the bobbin gear. Do not ıake the end too tight and be sure that the bobbin is well eated before starting the frame.
13. Put the waste collected in the proper receptacle, at the nd of the frame.

Tabulated Instructions for Doffing a Roving Frame

1. When the bobbins are half full, the frame mark should e put on the bottom end by someone other than the frame perative.
2. For slubbers and intermediates put empty bobbins on the obbin rail between spindles when the bobbins are nearly full. 'or finer frames put the bobbins on the roll beam, or have box of empty bobbins ready.
3. When the bobbin is full, stop the frame with the bobbin ail midway in its upward traverse. Lift the bottom cone and ıst start the frame enough to give the slack required in tarting the next set of bobbins. Have the pressers toward the ack of the fringe, with the flyers of the front and back pindles in line.
4. Mark the bobbins on the top for stock and size.

5. Clean the flyers of lint, etc., watching especially for oily rings at the top of each bobbin, around the spindle.

6. With the pressers toward the right, and the front and back flyers parallel to the frame, remove the front line of flyers, putting them crossed in pairs on the top-roll clearer covers.

7. Doff the bobbins in both lines; just lift off the front bobbins, lift off the back flyer and hold it back out of the way, remove the bobbin, pick up two empty bobbins putting them on the front and back spindles, and return the back flyer to the spindle.

8. Clean the roller beam.

9. Clean the bobbin rail. Turn flyers.

10. Wind the ends around the back line of bobbins.

11. Replace the front flyers.

12. Wind the ends around the front line of bobbins.

13. Move the cone belt to the starting position.

14. Drop the cone.

15. Pull the stop-motion lever into position.

Instructions for Doffing a Ring Spinning Frame

1. Have a truck with empty bobbins in the proper compartment and an empty box for the bobbins to be doffed.

2. Force the ring rail slowly to the lowest position just before stopping the frame (This puts on a series of binder coils to hold the yarn on the bobbin. It also makes finding the end much easier.) Lock the rail in this low position.

3. Jog the frame a few times to make a slack length between the rolls and bobbin. (Jogging is starting the frame but immediately stopping it before it accelerates to any extent.)

4. Lift the thread boards, thus lifting the thread guides out of the way.

5. Take a handful of empty bobbins, arranging them so that the tip ends are all up and held in the palm of the right hand.

6. Take a full bobbin off the spindle, leaving two or three coils spirally about the spindle. Hold the bobbin so that the bottom end is just above and a little to the left of the tip of the spindle.

7. Do not pull on the yarn below the rolls any more than is necessary.

8. Place an empty bobbin on the spindle, forcing it down on the coils of yarn.

9. Break the yarn by withdrawing the full bobbin when the empty bobbin is forced as far down as it will go. The bobbin may then be placed in the empty box. Greater speed is obtained by doffing several bobbins before placing them in the box.

10. When all the bobbins are changed, reset the builder for the first traverse of the new set of bobbins. (On warp frames

he traverse is not readjusted until after starting-up-doffers ıave pieced up the frame. This is done to cover up the piece-ıps and make it easier to piece up an end, because the traveler vill be kept as far away from the thread guide as possible.)

11. Lower the thread boards and guides.

12. Release the ring rail, holding it with a foot so that it vill not rise too quickly.

13. Start the frame carefully, meanwhile vibrating the ring ail slightly with a foot on the pedal of the lifter-rod arm. This lessens the traveler tension so that fewer ends break vhen starting.)

14. Piece up all ends that have broken down while doffing. (Grasp the full bobbin well below the nose when doffing to ırevent pulling yarn off the end. Move the traveler so it is at he back of the ring and out of the way of the bobbin.)

Instructions for Setting Spindles on a Spinning Frame

(These directions assume that the frame is not equipped with pindles.)

Take the ring rails off the frame and tie up the thread boards.

Clean the spindle rails thoroughly of any dirt.

Take the nut and washer off each base, insert the base in the pindle rail, replace the washer and nut, and tighten the nut vith the fingers.

Have all the projecting oil holes toward the front, all in the ame position except where they would interfere with the lifter ·ods.

Be sure that the band or tape runs free of the parts and that he rail is also clear of them.

Place all spindles on the frame this way.

Lift out the spindle, put the end of the blade in the bolster, ınd withdraw the bolster.

Adjust the bolster to the spindle.

Replace the bolster in the base, being certain that it goes lear down.

When replacing the spindle, put each band on its spindle base o give the proper direction of rotation, put the spindle in the ıolster, and slip the band on to the whirl. (Do likewise for he tape drive.)

Adjust all bolsters, and replace all spindles and bands in his way.

Oil each spindle.

Replace the ring rail, getting it in proper place and well seated.

Take off the drum gear or the twist gear.

Use a bobbin to fit the spindles, turned down to take a vooden collar $\frac{1}{16}$ in. less in diameter than the inside diameter ıf the rings used. This collar (or plug) should fit snugly nough to hold the bobbin at any position of the rail.

Chalk the surface of the collar thoroughly with some light chalk; white, yellow, and light blue are often used.

Set the ring rail at a position so that the upper flange of the ring is just level with the top of the collar when at its lowest position on the bobbin.

Start the frame.

Have a spindle wrench to fit the base nuts, and a medium-sized machinist's hammer.

Put the spindle and collar on each spindle in turn and move the spindle until there is the same space between the ring and collar at all points; that is, until the collar is concentric with the ring.

Tighten the nut well and inspect the collar to see that it still is in the center of the ring. Sometimes tightening the nut will spoil the first adjustment. When slightly out of position, the base may be driven into position with the hammer, using the handle of the spindle wrench between it and the base.

When all the spindles are centered in the lowest position, change the ring rail to a position at the top of the bobbin.

Adjust the collar to have the upper surface level with the upper flange of the ring.

Put the bobbin and the collar on each spindle in turn. If the spindle is plumb, the collar will be in the center of the ring; otherwise it will not be.

Have a supply of medium-weight, strong, brown wrapping paper cut into strips $1\frac{1}{2}$ in. by $\frac{3}{8}$ in. for plumbing the spindles.

When a spindle is not plumb note the point where the collar is nearest the ring.

Loosen the nut on the base sufficiently to allow placing a slip of paper between the base and the upper side of the ring rail, directly under where the collar was nearest the ring. The number of thicknesses of paper to use depends upon the amount the spindle is out of plumb.

Attempt to keep the spindle base in the original position on the spindle rail so that it will remain in the center of the ring at the lower position.

With the proper placing and the proper amount of paper, the collar should come in the center of the ring, when the nut is again tightened.

Lower the rail to the low position and test all the spindles that were readjusted at the top. It is quite likely that some will need readjustment. To readjust these spindles, loosen the nut a little and then drive the base into position, using the wrench handle and hammer.

Raise the rail to the upper position and test again, using more or less paper to correct any spindle not plumb.

Repeat testing the spindles until all are correct at both positions.

When all spindles are adjusted lower the thread boards to position.

Adjust each yarn guide on the thread board so the point where the yarn slips over the guide is directly over the center of the spindle. Use a specially built cap to fit the bobbin. This has a metal-pointed tip directly over the center of the spindle. When the cap is on the bobbin, have the point of the tip just touch the guide where the yarn is to slip over it.

Where wooden thread boards are used, the guide must be turned in or out and sometimes must be bent to one side to obtain the proper adjustment.

Where metal thread boards are used, a nut on the lower side must be loosened, the guide placed in the proper position, and the nut tightened.

Tabulated Instructions for Doffing a Picker

1. See that a lap rod is placed in the hole of the lap arbor before the lap is ready to doff.
2. Release the starting handle, if the picker does not have a lap-measuring knock-off.
3. Release the friction with the left foot and see that the lap racks run up high enough to remove the lap arbor. (Sometimes the lap racks will run freely enough so that the pressure on the lap will carry them high enough. If they do not run high enough, turn the hand wheel to bring them to the proper level.) Do not run the racks too high as it may cause them to be out of level when lowered.
4. Step to the right side of the picker and withdraw the arbor as quickly as possible, allowing the lap to turn as it naturally would. (If the arbor sticks to the lap, it is well to polish it. Bolted whiting or powdered black lead may be used very satisfactorily for this purpose.)
5. Place the arbor on the hooks just front of the calender rolls.
6. Remove the lap to the lap scale or to a lap cart.
7. Start the picker by lifting the starting handle, by hand or by foot.
8. As soon as the lap is out enough, put the arbor under the lap racks and guide the end of the lap around it. (Watch your fingers.)
9. Lower the lap racks as quickly as possible on to the lap arbor. Do this so that the friction is effective when the racks are at the lowest point and compressing the lap.
10. Weigh the lap doffed and record the weight on the sheet provided for it. (If a full finisher lap is more than one-half pound over or under the standard weight, reject it and send it back to the finisher apron.)

Tabulated Instructions for Stripping a Card

1. Stop the card

2. Remove the roll of flat strips.
3. Disengage the doffer gear (barrow gear).
4. Disengage the doffer calender and coiler gearing.
5. Put the stripping roll on the cylinder stands so it runs with the points down where it comes in contact with the cylinder.
6. Put on the shorter stripping-roll band from the loose pulley to the stripping roll, crossed.
7. Slip the main belt half way on to the tight pulley to turn the cylinder slowly. Keep the loose pulley up to speed all the time.
8. After one complete turn of the cylinder, remove the stripping-roll band, and lift the stripping roll out of the stand *at once.*
9. Move the main belt to the tight pulley.
10. Strip the stripping roll by turning it backward in the stands of the stripping box.
11. Put the stripping roll on the doffer stands as on the cylinder.
12. Put on the longer stripping-roll band, crossed.
13. Move the main belt part way back on the loose pulley to drive the stripping roll. The rest of the card will run by the momentum previously obtained.
14. Start the doffer in the usual way.
15. After one complete revolution of the doffer, remove the stripping-roll band, and lift the stripping roll out of the stands at once.
16. Strip the stripping roll as before.
17. When the web is up to weight, break it off clear across, hold the end in contact with the end in the doffer calender roll, and re-engage the calender-roll drive.

(NOTE: As the cylinder and doffer collect more fibers in the clothing just after stripping, the silver is likely to run light for some minutes.)

Instructions for Doffing Cards, Drawing Frames, and Combs

1. Have an empty roving can at the coiler of the card. Hold it with the left hand.
2. Grasp the full can with the right hand, with the fingers projecting over the sliver in the can to hold it in place as the can is removed.
3. Withdraw the full can, substituting, immediately, the empty can.
4. Break the sliver and make sure that the end is in the bottom of the empty can.
5. Do not release the sliver in the full can, but place one hand on top, holding the mass down. Press the top down and turn it to a vertical plane within the top of the can. (This prevents the sliver from expanding and falling over.)

6. Mark the sliver if necessary. Rub chalk on an old skewer nd then draw this across the top of the sliver which is in ie can.

Setting Drafting Rollers for Cotton Roving or Spinning Frames

1. Stop the frame.
2. Remove the clearers and place them on the creel.
3. Release the roll weights.
4. Remove the saddles, stirrups, and levers, placing them on op of the creel.
5. Remove the top rolls, placing them carefully on the creel i a roll box. Keep the rolls from the various lines separate. e sure the pairs of shell rolls do not come off the arbor or et separated.
6. Tip the cap bars back.
7. Disengage the draft gear and the middle roll idler gear.
8. Disengage the roving traverse gear.
9. Loosen, slightly, the middle and back steel roll bearings or the length of the frame.
10. Calculate the thickness of the gage required. (Note: in. plus $\frac{1}{16}$ in., which may be half the two roll diameters, subracted from the distance required between the centers of the olls equals the gage thickness required.)
11. Starting at the head end of the frame, place the gage etween the bosses of the front and middle rolls, nearest every ther roll stand, and tighten the bearings in position. (This done to get rolls set quickly, thus reducing the chance of oringing them.)
12. Then gage the rolls at the other bearings and tighten them.
13. Tip down the cap bars.
14. Replace the top rolls. Put them on so they turn in the roper direction. Be sure shells are properly mated as when aken off. Put right rolls on the middle line.
15. Adjust the bearings on the cap bars so that the top rolls re directly over the bottom rolls.
16. Reset the gearing of the traverse motion, being careful o see that the gear meshes with the back-roll worm.
17. Reset the draft gear, and the middle-roll idler gear.
18. Replace the saddles, stirrups, and levers, being careful to re that the levers are all the same height from the beam.
19. Clean and replace the clearers.
20. Start the frame carefully and piece up the ends broken uring setting of the rolls.

utting on Tapes Spinning Frames and Twisters

Note: Directions enclosed in parentheses are for twisters.

1. Stand facing the machine on the side on which the idler pulleys are hung.
2. With a band hook and weight, put one end of the tape over the top of the drum, and draw it back from the under side.
3. Keep the tape straight and hold an end in each hand, the one from the under side of the drum in the right hand.
4. Turn the end in the right hand one complete revolution to the right or clockwise (to the left).
5. Lap one end over the other 2½ in., being sure the end in the right hand is placed on top (underneath) that in the left hand.
6. Stitch the two ends together in this position, around the edges and ends, diagonally and across both ends.
7. Place the end in the left hand around the two spindles of this side to be driven from the left to the right (from the right to the left).
8. Pass the end from the right hand (left hand) over the top of the drum.
9. On the opposite side of the frame, take the loop from operation 8, so the tape will lead straight across from the opposite spindle. This was on the right; it now is on the left.
10. Place the loop around the two spindles opposite those on the other side from the left to the right (from the right to the left). Have no twists in the tape.
11. Returning to the idler side of the frame, place the tape on the idler pulley.
12. Have a proper tension on the tape.
13. Adjust the idler as a guide pulley so the tape will not run off. This idler will need to be just to the right (left) of the left (right) hand spindle of the two which the tape drives.

Starting-up Cotton Card After Grinding

The following instructions are for starting up a cotton card after grinding:

1. Stop the card.
2. Take off the main belt and the cylinder-doffer belt.
3. Set the doffer to the cylinder.
4. Set the doffer comb to the doffer.
5. Set the licker-in to the cylinder.
6. Set the feed plate and mote knives to the licker-in.
7. Set the flats to the cylinder.
8. Turn the cylinder, doffer, and licker-in by hand and listen for contacts.
9. Put on the licker-in and cylinder belt, the doffer belt, the flat belt, the doffer-comb bands, and the doffer gear (if removed for grinding).
10. Put on the main belt.
11. Start the card carefully and listen for contacts.
12. Put in the lap and re-engage the side-shaft gears.

13. Start the calender rolls when the web is in good shape.
14. Discard the first few yards because of possible dirt and light weight.

MACHINES, LAYOUTS, AND SPEEDS FOR COTTON OPENING AND CLEANING

By Charles A. Weston

There seems to be some confusion in the minds of cotton men as to the distinction between opening and cleaning machines. Under "openers" the following machines are generally listed: bale breaker, hopper feeder (sometimes called "opener"), vertical of Creighton opener, exhaust opener, and a machine having a beater similar to that in the vertical of Creighton opener but in a horizontal position. Then there is another machine, apparently little known, which is similar to a drawing frame in that the principle of drawing out the stock by means of rolls is used. It should be noted, however, that some of these machines are called cleaners by men who should know. The machines which are more generally considered cleaners include the horizontal cleaner, Murray cleaner, centrif-air machine, striking beater, Buckley section, and similar machines.

Dual-Purpose Machine

The C.O.B. machine can possibly be classed as both an opener and a cleaner, due to the fact that the prongs or wires within the passage, in conjunction with the air force, cause a shaking action and assist in fluffing the stock passing through. The up-and-down action causes the foreign matter to be directed to the space for it, the down action or force in particular assisting the foreign matter to find its place.

Cleaning Efficiency

The cleaning or dust trunks are considered in a class by themselves; for, after the stock has been opened and cleaned to some extent, some of the dirt and foreign matter still in it is allowed to drop through the grids, knives, or bars as the stock is passing through to the next process or department. It generally is a section that exerts no positive action, such as agitating or shaking, and its value varies according to the type of stock.

There is no question but that the cleaning efficiency of a section or machine depends mostly on the amount of opening done previously, although of course it is affected to a considerable

extent by the grade of cotton in use and the methods employed. When results are not just what they should be, speeds are usually changed at the beater and fan, and settings are altered in some instances between bars and between bars and beater.

Variety is the spice of life, and at times it is possible by changing the order of the machines to obtain better results. There is no rule to the effect that a high-production machine should not be placed before a low-production machine, or vice versa, but the feed and delivery should be controlled properly from one to the other and the product from one should be in such a condition that the next machine can cause no damage. Many times the production cannot be brought to a satisfactory point due to amount of space, kind of stock, and machine conditions.

Without much justification, many mill men compare opening equipment with cleaning equipment, and individual machines with others of the same classification, on a basis of the amount of dirt taken out. That is to say, they believe that the efficiency of a machine or combination is not so good as that of a previous machine or other combination unless it has taken out just as much dirt. In many cases the drops, dirt, and foreign matter are more from one combination than from another due to the type and amount of opening, and not to the number or type of cleaning machines. At times it is interesting to note that the droppings, dirt, and foreign matter weigh practically the same from one machine or combination as from another; yet there is more good stock in one than the other. Practical experiments made by far-seeing individuals experienced on different makes of machines and with different ideas will prove of more value than will opinions based merely on superficial differences.

Preparatory Opening and Blending

Practically all combinations of opening and picking equipment have one or more bale breakers or hopper feeders. At least one machine builder has brought forth the idea that this type of machine, when used the second or third time in a combination, will be more efficient in its blending or mixing if the angle between the feed apron and spiked apron is reduced. The writer personally believes that the best blending or mixing should be done either before or after the first bale breaker or hopper feeder. Experience shows that by reducing the space between the spikes on the spiked apron and the pins on the stripping roll better opening is obtained but the production is decreased. The same is true if the speed of the stripping roll is increased. This would also be true if the speed of the spiked apron were reduced. Many times a mill believes that it has to sacrifice everything for production in the preparatory processes, rather than sacrifice production for quality. The result of this policy

is that in the later processes the mill has to sacrifice production because of end breakage, poor roving and yarn, and generally unsuitable conditions.

Before completing a discussion of the bale breakers and hopper feeders, it should be noted that, especially on some hopper feeders, there are grids or bars and a draw-box under the doffer roll. All who have investigated the value of these devices have noticed that the dirt or drops in this draw-box consist of considerable fine leaf, sand, stalk, and similar foreign substance. Good stock falls into this draw-box only when there is too much space between bars, due in most cases to bent or missing bars. By experimenting with the doffer-roll speed it is possible to change the amount and type of cleaning done; that is, if it is not already efficient.

Bale breakers or hopper feeders are the best machines to use in preparatory opening and blending of stocks, providing a method similar to what has been called the battery-of-hoppers system is used. Fig. 1 shows the old method. Fig. 2 shows the average method in use at present. Fig. 3 illustrates a battery of hoppers on a regular extension apron. Fig. 4 is an arrangement for mixing cotton of different grade and character.

The Vertical Opener

Let us next consider the vertical or Creighton opener. The beater speed of this machine varies from 450 to 800, depending on the opinion of the man in charge. If the stock has been opened previously so that it is fluffy or expanded, the speed of the vertical beater can be higher without causing damage than if the stock is in hard, compressed lumps or bunches. This fact, however, does not necessarily mean that the speed should be higher.

Either grids or screens are used around the beaters of vertical openers, and foreign matter is forced out in either case largely by centrifugal force. The grids, however, further assist the opening of stock and the removal of foreign matter by presenting a rough surface to the cotton and directing the foreign matter to the space for collection.

The vertical opener is usually the first machine to be blamed when the question of curly cotton arises. A few reasons for the curling of cotton by this machine include too much moisture in the cotton, stock fed too heavily, tufts too bulky or stock too compact, and stock not previously opened enough to prevent its becoming wedged between the fingers and the grids or perforated screens.

Many mills using two vertical openers in tandem adopt the same speed for both. This is wrong. To obtain better cleaning, the second vertical opener should be run slower than the first, the actual speeds depending on the condition of the stock fed. Providing proper ageing and a certain amount of hopper open-

ing have taken place and the stock is not too condensed when fed, the writer prefers speeds around 500 r.p.m. When the stock is moist and made up of hard tufts, however, it is necessary that the beater travel at a much higher speed in order that it may lift the stock properly. In many cases the propeller blades have to be made larger because of the condition of the stock.

There naturally is a happy medium for a vertical-opener speed, but the writer believes in running the second vertical opener as slow as possible, providing the stock when delivered from the first vertical opener is fluffed and has been returned to as natural a condition as is possible by machine processes. The writer recalls a small experiment made a few years back which showed better cleaning and the removal of less good cotton, more sand, and fewer regular motes when the beater speed was decreased. The only unfavorable feature was the decrease in motes, but these were taken out by the following beaters.

Before leaving the vertical opener let us give due credit to it as the most efficient sand remover. China cotton is best opened when vertical openers are included in the layout.

Horizontal Cleaners

There are two types of cleaning machines to be considered. One type uses centrifugal force as its principal means of cleaning, employing no feed rolls. Although the other type uses centrifugal force, it also uses regular beating, dusting, or shaking, obtained by the help of feed rolls.

The type that uses centrifugal force as its principal means of cleaning receives its stock on one end or side and delivers it on the other. With this type of machine the stock must not be retarded in its progress from one end to the other, else it will become damaged. The speed of the beater and the methods used in directing the stocks are very important factors. The efficiency of this type of machine is increased with good opening in previous machines. Most of these machines that have been studied by the writer use screens, some revolving and some stationary. The condition of the stock delivered does not appear to be altered so much by whether the screen is revolving or stationary as by an increase or decrease in circulation of the stock and air.

The second type of cleaner mentioned is similar to the Buckley. This type of machine appears to have first resembled a porcupine beater. Later its diameter was extended, the grids or bars were increased, and the direction of the beater was changed. Tests on these machines appear in many instances to contradict themselves, and ideas regarding them are so varied that one opinion, based on either facts, figures or hearsay, appears to be as good as another. Reasons for the con-

radictory results include differences in speeds, organizations, ıethods, settings, conditions of equipment, conditions outside ıe equipment, and the men who outline and conduct the tests r investigations. Instances have been noticed in which proper leaning of the stock has not been accomplished due to the ıachine not having been cleaned underneath at regular inter- als and before it became filled. There was a time when the onstruction of this machine made it very difficult to clean, and ıis possibly was the operator's excuse for not cleaning it at the egular intervals.

Occasionally it appears as though in the second type of leaner the droppings consist of a considerable quantity of good tock, due to an exaggerated spacing between feed rolls and the ɔp grid, and also to the fact that the grids have been altered o that there are a few that are either set too high or are set t an angle that is against the principle of correct cleaning. It ; interesting to note the different types of fingers or blades on he beaters of these machines, and also the angle of the indi- idual fingers or blades. There have been several instances in vhich laps produced from a combination consisting of Buckley ır similar types of beaters are fluffy or too bulky in appearance. This condition tends to cause considerable waste, due to the ıreaking up of laps when they are handled, no matter how care- ully it is done. This condition has been remedied in certain nstances by increasing the beater speed and decreasing the an speed.

It should be mentioned that every machine (whether a cleaner ır opener), every type of conveyor or distributor with or with- ıut condenser, and every attachment assists in both cleaning and ıpening the stock. It would therefore not be correct to say hat after eliminating an individual machine or section just as ;ood results are to be obtained, unless some change is made on he remaining members of the organization.

The ordinary conveying lattice apron can be altered slightly o that it will remove considerable fine dirt and leaf by merely llowing enough space between slats for the dirt to drop. Many ıprons have the slats so close that it is almost impossible for he finest of dirt to drop before it is blown or carried into he next process. The rake conveyor is growing in popularity, ıt least partly because of the slight agitation afforded by the akes, which serves in some instances to push and turn over he stock, and because of the use of either perforated plates ır cleaning bars directly under the moving stock, which permit he dirt to drop into chambers.

Picker Beaters

Years ago the regular beaters, with the assistance of one ıopper, did the opening and cleaning, and mill men appeared o be more satisfied with the results obtained than today. Now

it sometimes appears as though none were satisfied. This is due to the fact that competition is so keen that the best is none too good, and to be satisfied is almost to admit that the end is near.

From tests made a few years ago by an organization that specialized in mill problems, it appears that a combination of one two-blade and one three-blade beater affords a yarn that is stronger but not so even as that obtained from a combination of one two-blade and one Kirschner. The droppings from the Kirschner were shown in these tests to have more leaf and dirt and slightly more lint or fiber than the droppings from the blade beaters, but the blade beaters had larger motes.

It is common practice or habit to tell how many blows per inch the stock is getting when these beaters are used, even considering the combing action of the Kirschner beaters in terms of blows per inch. Years past, when three processes of pickers were used, the total blows could be figured for the average mill as approximately 120 to 150 per inch. To recommend this to the mill of today would be out of order, due to the greater amount of opening and cleaning equipment now considered necessary before the regular beaters and picker sections are used. Where three beaters are used today the total blows will range from approximately 70 to 90; and where two beaters are used from 40 to 70, in the case of blades and Kirschners.

When using Aldrich, porcupine, or striking beaters, the condition of the delivered stock will vary according to the speeds in use, such as beater and fan speeds, and to the relation of the surface speed of the beater to the surface speed of the feed roll. It is almost impossible to recommend a speed that will give the best results in all mills, but it is possible to recommend a speed to any given mill from which it should work as a basis

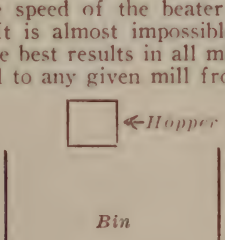


Fig. 1. Old method

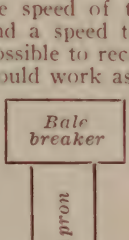


Fig. 2. Usual method

for its experiments. When considering blows and also the different beater speeds, we also should take into consideration the stock itself. In comparing results in different mills we should consider how the stock is held while being acted on, and how heavy it is per yard. One mill after considerable experimenting found that the angle of the grids had more to do with

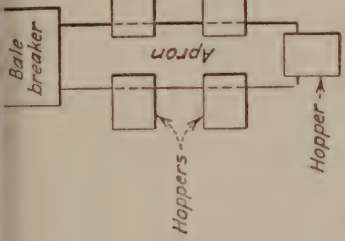


Fig. 3. Battery of hoppers on extension apron

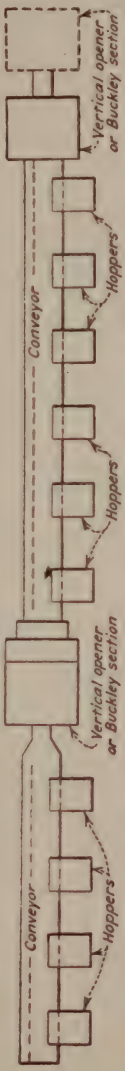


Fig. 4. Arrangement for mixing different grades of cotton

ıe cleaning done by the picker than the many other changes ıat they had made.

OPINIONS ON COTTON CARDING PROBLEMS

Based on Long Practical Experience

By John T. Kersey

The quality of any cotton fabric, whether knitted or woven, is dependent very much on the efficiency of the cards, which is governed by the mechanical condition of their working parts and also by the way in which the necessary duties of the attendants are carried out. It is a common idea that defects in the work of the employees at the early stages of cotton spinning are lost or made ineffective before the work reaches the looms; but this is not true, as has been demonstrated a good many times. Faults which may precede those caused in carding include insufficient length, variation in length, and harshness of the staple; unsuitable mixing; wrong moisture content; and variation in weight and thickness yard for yard of the laps.

It very seldom happens that the cards are bothered with too much water in the cotton; but very often in dry weather—especially if it is windy and cool, and if no moisture is present in the room and very little in the cotton—static electricity causes the cotton to cling to the clothing. This breaks the ends down and gives lots of trouble while it lasts. The remedy is moisture in some form—either as wet steam or as water from humidifiers.

The high percentage of foreign matter, which is composed mostly of leaf, motes, and dirt, if left in the cotton by the pickers, adds greatly to the work of the cards. If this foreign matter has to be completely removed by the cards, it will lower the production considerably at this process and run up the cost per pound. This makes it very necessary for the cotton to reach the cards in as clean a condition as possible.

Possibilities in Laps

Laps of middling cotton are being made today on some of the modern machines which carry as low as ¾% waste of foreign matter and vary only about 3% in the weight per yard and the unit weight. I know of one machine that made laps from 40½ to 41½ lb. for a week with only a few of them slightly heavier and lighter and with no adjustment of the evener during the time. A good picker man can probably make laps on any picker weighing 40½ to 41½ lb. by setting back half the machine makes and continually adjusting the evener. With

ı old worn-out evener the variation will sometimes be as uch as 7 or 8%, regardless of the total weight of the lap. f course this unevenness cannot be overcome at the card, and only partly corrected at the drawing frames by the doublings. Carding proper consists of reducing the weight of the lap or awing it out into sliver, taking out all foreign matter, and ıralleling the fibers. Quality in carding must not be sacri-ed for quantity. There is a limit to what a card can do on ch kind of stock. A card that can produce maximum quality ıd quantity at the same time must be 100% mechanically rfect and get laps from the pickers free from all defects. 'here the card has little foreign matter to remove and only afting and paralleling to do, the cotton can be put through uch faster.

Draft and Weight of Sliver

Opinions as to what is a good practical draft for a card ıry among the many carders in the industry, but range tween 90 and 120. Being a carder of a good many years' perience and having tried a great many drafts of different ngths, I have learned that both long and short drafts have eir commendable and objectionable features.

A long draft feeds the stock into the licker-in slower, giving longer time for the combing action to take place. This epares the fibers for the action of the cylinder. On coarse ork, however, it has the disadvantage of making the lap too ick. If the lap is too thick, the feed roll does not hold it operly against the feed plate and lets portions of it go into ıe licker-in in lumps. This causes cloudiness in the web. f course this can be overcome by applying more weight on ıe roll, but the additional weight will require more power.

On the other hand, a short draft and light lap allow the otton to run in faster, and change the combing action of the cker-in, but the lap is held better by the feed roll and gives ss trouble from chokes.

Taking 165 r.p.m. as the correct speed to run the cylinder, ıd referring to the accompanying diagram, we get the surface peed of the licker-in by the formula

$$\frac{165 \times a \times 3.1416 \times 9}{b}$$

This works out to 11,994 in. per minute. The surface speed f the feed roll is found by the formula

$$\frac{165 \times a \times e \times H \times F \times D \times 3.1416 \times 2.25}{b \times f \times G \times E \times C}$$

$$\frac{165 \times 18 \times 4.5 \times 16 \times 23 \times 3.1416 \times 2.25}{15 \times 7 \times 192 \times 160}$$

This works out to 10.74 in. per minute.

The surface speed of the licker-in is therefore 1,116 time the surface speed of the feed roll (11,994 ÷ 10.74). Now t shorten or lengthen the draft will of necessity change the rati between these surface speeds, and to a certain extent chang the effect of the licker-in in combing the stock. However, a the difference between the surface speeds is so great, the effec caused by changing the draft either way cannot possibly amoun to much, unless the change is a very radical one.

Weight of Sliver

Weight of the card sliver should always be as light as it i reasonably possible to have it. It will vary in practice fro 40 to 75 grains, but I have found that it is better not to go ove 60 grains, even if the cards have to be run through the noo hour. Heavy card sliver requires longer drafting, and affect the quality and running of the work in the processes following I would much rather run 60-grain sliver and make up th difference in increased doffer speed than get the same produc tion with 75-grain sliver and a slower doffer speed.

I have found by experiment that an average card hand ca look after twenty cards—keep them lapped, doff the cans a they fill up, and do the cleaning systematically—if the doffer are making 13 r.p.m. and producing 60-grain sliver. By usin the following formula and allowing 5% for stoppage, it wil be seen that the production per day of 10 hours will be

$$\frac{3.1416 \times 27.75 \times 13 \times 600 \times 60}{36 \times 7000}$$

This works out to 162 lb., and this less 5% gives a net pro duction of 154 lb. per day. Around 150 lb. per card per te hours is in my opinion the limit, if first-class carding is desired

Now if we accept 13 r.p.m. as a maximum doffer speed an 154 lb. net of 60-grain sliver per day of ten hours as a maxi mum amount for a card to produce, the corresponding produc tion for a card producing 40-grain sliver will be (154 × 40 ÷ 60 = 102.6 lb. This can truly be considered all a car should do on that weight of sliver. The doffers can be ru somewhat faster than 13 r.p.m., but the chances of bruise wire and other damages when the ends come down are muc greater, and the ends are harder to put up, resulting in mor waste being made by the help.

Causes of Bad Carding

Any defect in the web can be classed as "bad carding," bu this does not necessarily mean a mechanical defect in th running surfaces or settings. A card may be in first-clas condition, and yet produce sliver which contains more or les leaf. If the card is sharp and set up properly and yet th

veb contains leaf, the only remedies are to take more leaf ut in the picker room and reduce the production of the card. These changes will, of course, help the quality of the carding, ut will increase the cost per pound.

Regardless of the class of work a card has to produce, it hould be stripped before it needs it; i.e., before the clothing ills up and begins to produce neps. This may mean stripping wo or five times per day, depending on the stock and the roduction of the card. After the stripping, no matter how t is accomplished—whether by vacuum or by brush—there hould not be left any filth or foreign matter embedded anyvhere in the clothing. If such material is allowed to stay n the wire very long it will rot the clothing, loosen the wire, nd make it necessary to put on new fillet. Such practices s skipping cards while stripping and letting all the cards run oo long without stripping show up badly in the cloth. The loth is given the same appearance as when low-grade cotton s used with white stock without the dirty cotton having been iven a cleaning before mixing.

Cloudiness in the Web

Cloudiness can be caused by almost any irregularity in the ap, but comes mostly from bruises or abrasions in the doffer vire, improper setting of the doffer to the cylinder, bad licker-in vire, or too wide a setting of the licker-in from the feed plate r cylinder. The surface of the damaged doffer wire must be nade smooth by carefully scraping up the low wire and, if ecessary, grinding with the solid or drum grinder until all he wire is brought to the same plane or level—finishing with he regular traverse grinder. If the licker-in wire is damaged o such an extent that it cannot be put in first-class shape, it hould be replaced with new.

The licker-in should be set to suit the weight or thickness f the lap being used. This setting will vary from 7/1000 to 5/1000 for laps weighing 12 to 15 oz. per yard. Too close a etting between the licker-in and the feed plate will break or veaken the fibers, and cause the yarns and cloth to have a low reaking strength. It has been demonstrated that the farther he licker-in can be set from the feed plate without causing loudiness, the greater will be the breaking strength of the arns. It may be said that to a certain extent the licker-in is o the card what the beater is to the picker. Very often, however, this fact is overlooked. One would not dare try to run n unbalanced beater or one with bent shaft or worn bearings, ut such a condition can often be found around the cards.

Cloudiness throughout the web causes unevenness in the oving and yarns. The roving will not draw evenly, regardless f how the rolls are spaced. Only a perfect web with even taple will make even roving and yarns. Cloudiness shows up

in the cloth mostly in light and heavy places in the thread and can range in length from a few yards to 125 yd. or more. In the warp a light thread will show up beside a heavy one, but in the filling on a single-shuttle loom a light or heavy strip three to five threads wide may be caused, depending, of course, on the total drafts of the machines and the width of the cloth.

Neps in the Web

Neps are the result of the clothing getting too full before it turns the cotton loose. They are made mostly between the flats and cylinder and between the doffer and cylinder, due to dull or hooked clothing, too much oil or water in the cotton, or too wide a setting. Neps are also caused by loose wire on the cylinder or flats and by low places on the licker-in wire which reach all around the licker-in and allow lumps to go in continually at one place. This latter cause is very easy to locate, as the flats fill up at one point on the running surface opposite the low place in the licker-in wire. The only remedy for neps is to have the clothing firm, sharp, and properly set up—as close as possible without rubbing. On light carding, 40- to 50-grain sliver, and with good clothing, the setting between the flats and cylinder can be as close as 5/1000 to 7/1000. On carding from 55- to 65-grain sliver the settings can be as close as 7/1000 to 9/1000.

The same settings give good results between the doffer and cylinder. The best results are obtained with the flats when the back flat is set a distance from the licker-in which is slightly greater than the distance of the front flat from the cylinder. It is also very important to have the setting at each end of the card the same as at the opposite end; otherwise one end of the cylinder will always be loaded heavier than the other.

Neps hang on and twist into the roving and thread. They are not only detrimental to good breaking strength, but show up badly in all kinds of fabric. They are particularly bad in colored goods with white filling. Some mills scrape a large percentage of them off in the cloth room, but the best way to keep them out of the goods is not to make them.

Weight and Waste

The causes for variation in the weight of card sliver are legion. Light or heavy places in the laps cause variations in the weight of the sliver from all the cards. There is usually variation in the weight between the different cards using the same weight of lap. This condition can be found to a certain extent in almost any mill, but is, of course, worse in some than in others. This would not happen if each card could be made to take out the same amount of waste, but this condition is

ıard to attain. The matter of obtaining uniform waste from he cards does not receive the attention that it should in a ;reat many of the mills, especially in those that reclaim the vaste and put it into a by-product. This in my opinion is)oor policy, as the evenness and quality of the main product ;hould be considered first.

When making the better grade of goods there should never)e any strips put back into the mix, and the cards should be ;et so as to take out about 2.5% of this type of waste. On the ower-grade goods it is much better to take out a very small)ercentage than to take out a large amount and put it back in he mix. This will give cleaner work and better breaking ;trength. It is a known fact that carding the same cotton con-inuously will invariably weaken it, especially in the case of)oor stock such as the strips are composed of. When the strips ıre put back into the work, the only cleaning the work gets is ıt the licker-in.

It has been proved beyond a doubt that the same setting of ;ach card will not take out the same amount of waste. This s largely due to the fact that the air currents of each card ;ary considerably. This being the case, the right setting must)e found for each individual card. This applies both to the tripping plate and to the mote knives. There is quite a dif-erence between setting the mote knives of a card to knock)ut everything, including as much good lint as dirt, and setting hem so that they will knock out only the dirt, leaf, and other oreign matter.

Action of Licker-in

If the individual fibers in the lap went into the licker-in traight and in a parallel position, like that in which they pass hrough the rolls in some of the succeeding machines, no doubt he cleaning by the licker-in would be much more thorough. 3ut this is not the case. The fibers point in all directions when he licker-in tackles them. Some of them enter sideways. Some ıssume a circular form. Some, no doubt, are held for a short ime by the feed roll, giving the licker-in a little time to comb he foreign matter off of them. Others go to the cylinder at)ne sweep.

Referring again to the diagram, it will be seen that the icker-in makes 424 r.p.m. when the cylinder makes 165.

$$\frac{165 \times 18}{7} = 424.3$$

The feed roll makes

$$\frac{165 \times 18 \times 4.5 \times 16 \times 45 \times 23}{7 \times 15 \times 192 \times 45 \times 160} = 1.524 \text{ r.p.m.}$$

The feed roll delivers $1.524 \times 3.1416 \times 2.25 = 10.77$ in.)er minute.

If the feed roll delivers 10.77 in. of stock while the licker-in

makes 424 revolutions, the beats or combs per inch for any single tooth on the licker-in will be $424 \div 10.77 = 39.36$. Now allowing 7 teeth per inch in the wire around the licker-in, each inch of stock being delivered will be operated on by $39.36 \times 7 = 275.52$ teeth, and each square inch will be operated on by $7 \times 7 \times 39.36 = 1928$ teeth.

If we change the draft gear *D* to 25 teeth, which is shortening the draft 2 teeth, the speed of the feed roll will be $(1.524 \times 25) \div 23 = 1.651$, and the inches delivered per minute will be $1.651 \times 3.1416 \times 2.25 = 11.67$. By calculations similar to those just explained, the combs or beats for a single tooth will be 36.33, each inch of stock entering the licker-in will be operated on by 254.31 teeth, and each square inch will come in contact with 1780 teeth. There will be 1928—1780, or 148 teeth less per square inch than with the 23-tooth gear. By thus shortening the draft two teeth, we make only a difference of 8%, and find that 148 less teeth are operated on the stock per square inch.

Now if the draft is 120 and we are to change it to 90—a decrease in draft of 25%—the difference in the number of teeth combing or striking each square inch of cotton would be $1928 \times .25$, or 482, less. I shall leave it to my readers to decide which draft is best.

Stretched Work

Stretched work at the cards is the result of too much tension or draft between the doffer and the calender rolls, or between the calender rolls and the coiler rolls. Once the right compensating gear is put on the calender roll, there will hardly be any stretched work between the calender and coiler rolls unless the coiler trumpet becomes worn too large in the bore. Stretching between the calender rolls and doffer is liable to happen most any time on a dry, windy day in a mill in which atmospheric conditions are not adequately controlled, especially if the end calender-roll gear produces very much draft at this point. If the doffer comb is set too high, the web will run too tight and pull in at the selvage.

The surface speed of the calender roll should be only sufficiently in excess of the surface speed of the doffer to keep the web from lagging and breaking down. This will require a draft at this point of about 1.05 on a normal day, with the doffer combs set at the right elevation. This speed, however, might run the ends a trifle too slack on a very damp day, and cause them to lag too much. The only thing to do is to strike a happy medium, which in practice is slightly more draft than mentioned above.

A good method for getting the draft just right at this point is to divide the circumference of the doffer by the circumference of the calender roll in order to determine the revolu-

tions of the calender roll required for it to equal the surface speed of the doffer, and then divide the teeth in the large doffer gear by the speed of the calender roll to find the gear required on the end of the calender roll to give the same surface speed as that of the doffer. Referring to the diagram, the circumference of the doffer is $3.1416 \times 27.75 = 87.17$ in., and the circumference of the calender roll is $3.1416 \times 3.9 = 12.25$ in. $87.17 \div 12.25 = 7.11$ revolutions of the calender rolls to equal one revolution of the doffer. $192 \div 7.11 = 27$, the calender-roll gear required. This puts both the doffer and the calender roll running at the same surface speed. Any smaller gear will add draft in proportion to its size.

Sliver that is stretched at the cards is somewhat improved at the drawing slubbers and roving frames by the doublings that are employed, but it is by no means corrected in full. A good many times several light places come together, especially at the breaker drawing, and the result is a very light place that will look light in the cloth, be weak, and break a good many times more than the heavy threads will.

Lumps and Heavy Places

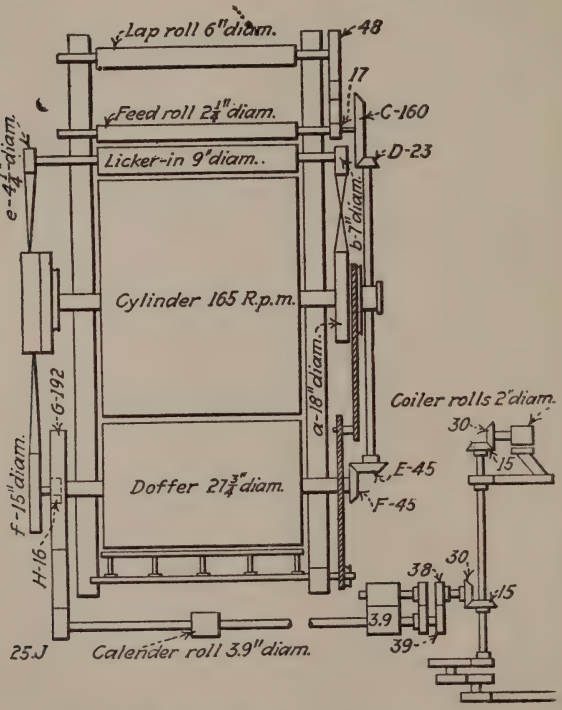
Heavy sliver from the cards is made in several ways. A great deal of it comes from lumpy or defective laps, a large portion from split laps, and some of it from rough places on the screens which collect lint to a certain point and then turn it loose. When lumps come from rough places on the screen, they can be overcome by fixing the screens, but getting the defects out of the laps is altogether a different proposition.

Each department of the mill has to put up more or less with the defective work from the department that is supplying it, and should do the best it can with what it has. If this is put into practice around the cards, it will greatly improve the looks and quality of the work, besides making it run better throughout the mill. Although a smart, conscientious card hand is a good asset to any mill, I would rather have an average card hand and a good coiler trumpet bored to the right size to suit the weight of the card sliver. However, both together make a good working combination. The hand should be capable and honest enough to catch very nearly all the heavy work and pull it out.

If the trumpet is bored to suit the sliver, it will stop all heavy or lumpy work made in the picker room by defective screens, but the trumpets will not stop the single, or light, work. To get this out requires strict discipline, and conscientiousness on the part of the foreman and the card tenders.

The right trumpet bore for any weight of card sliver can

be found by the formula, $\sqrt{\text{grains per yard of card sliver}} \times 1.2 =$ the bore in 64ths of an inch. Trumpets bored according to this formula will catch any places that are as much as 10% heavy. If the general variation on the heavy side is more than this, allowance must be made or the variation corrected; otherwise, the breakage will be very great and will cripple the production considerably. Heavy threads in the



Gearing Diagram of a Cotton Card

cloth do more damage to the appearance than anything else, although they do not hurt the breaking strength. Appearance, however, governs the selling price to a great extent.

Insufficient Cleaning

To get good work from the cards, systematic cleaning should

not be overlooked, either on the inside or the outside of the machines. Lint allowed to accumulate on the outside of the cards very often is blown into the work, and whether dirty or clean finds its way into the weaving or knitting room, breaking ends or spoiling the appearance of the goods. If the housings that catch the droppings from the screens, mote knives, and doffer are allowed to fill up before being cleaned, the dirt and other foreign matter cannot be removed and will go through with the regular work. Left in, they will fill up the spooler guides with leaf, motes, and dirt. What gets through and into the cloth gives the goods a very trashy, leafy appearance, as though low-grade cotton had been used and only slightly cleaned.

Conditions like this come about sometimes as a result of changing the grade of the cotton from better to worse and not changing the time for taking out the droppings to suit the quality or grade of the cotton being run. A card that is in good carding condition will get considerably more leaf and dirt out of low-grade cotton than it does out of clean stock. To overcome a condition of this kind is very simple. The only thing necessary to do is to make a test and see how long it takes for the boxes to fill on the lowest grade of stock that is to be used. They should be emptied before this takes place.

Oil, both clean and dirty, gets on the sliver in several ways, but mostly from leaky bearings on both pickers and cards. Careless oiling and overdoing it, especially in the comb boxes, will invariably throw oil into the work or on the sliver. This will go through and into the goods, and finally show up as oil stains, making the cloth bad and affecting the selling price. It gives the finishers trouble in bleaching or dyeing. Piecing with dirty hands gives practically the same effect.

RESETTING THE COTTON MULE

A Procedure Periodically Necessary

By William King

The work of resetting the cotton mule may be divided into two parts: the perfect alignment of all motions intended to run in parallel lines, and the renewal of all worn or broken parts. An article of this nature will serve the most useful purpose if the procedure followed during resetting work is outlined step by step.

Preliminary Steps

It is necessary, first of all, to strip the mule so that the different parts can be thoroughly cleaned and examined; and it is usual to begin in the following manner. Take out all leather

rollers and place them on top of the creel, together with the big saddles, each big saddle being placed with its own set of rollers to save labor in leveling the roller weight levels. All the roller cap bars may be taken out, and, as these are easily broken, placed in some safe place. The front line of steel rollers must then be uncoupled, and this is done by using a pair of roller tongs.

Examine each roller carefully to ascertain if the neck is worn, if it is loose on the square, if it is strained, or if it requires refluting. Very often these defects are present, and can be remedied by the machine maker, or in the mill machine shop. Difficulty may be found in removing those rollers connected to the front spindle at the headstock; and to remove them without straining them, a clip with a hole the same diameter as the roller neck is used. The clip is split and can be placed on the front roller neck and the roller tongs used in the usual manner. The back and middle rollers may be examined, and allowed to remain unless found to be defective. The roller stands, roller beam, and back-shaft bearings may then be thoroughly cleaned.

Now the Carriage

Attention may now be paid to the carriage. The top and back boards can be removed, and all the spindle bands cut off. The tin rollers can then be taken out. To do this slacken all the tin-roller set screws in the end of the tin roller which is farthest away from the mule out-end, and this will leave the arbors in the best position when the tin rollers have to be replaced. The tin-roller bearings at the carriage ends can then be removed, and the tin rollers taken out. Each tin roller must be examined to ascertain if it is out of balance, dented, or the ends damaged, and the necessary repairs made. After taking out the tin rollers all parts of the carriage should be well cleaned.

The first leveling operation can now take place. The rails or slips on which the carriage makes its traverse are usually 6 ft. in length, and have wood packings under each foot for leveling purposes.

A beginning may be made at the end of the mule, the carriage over each slip jacked up, and the carriage wheels removed. Thus by means of extra wood packings and a spirit level the slips can be set. All the holding-down screws should be made firm and secure. It is essential that this work should be carefully done, so that the carriage will have a firm foundation on which to run.

Raising Headstock

The next operation is to bring the headstock to the same

eight as the out-end stands. When a mule has been running or several years it will generally be found that the head-tock, owing to its weight, has sunk a little below the level f the out-ends. If the headstock has sunk only a little, and ıe wood packings and foundation are quite good, the three oints may be brought into line by dropping the out-ends a ttle. The method generally adopted to find out how much the eadstock has sunk is known as sighting.

It is well known that a quick method of determining whether ertain points are level is by glancing along them. This ıethod is used often in practical mechanics. When it is used ı the mule, three brackets are secured to the roller beam, each ith its top edge a certain distance above the roller beam. ne bracket is secured at the headstock, and one at each out-ıd. When standing at the out-end, it is possible to ascertain y glancing along the roller beam, whether the headstock is ıe correct height, or whether it has sunk. If it has sunk, then ew wood packings must be placed underneath until it is the rrect height.

To level the headstock itself, a spirit level is used on the ont spindle, and this will indicate whether extra packing required at one side of the back of the headstock, or whether ı amount must be planed off the existing packing. When ıe headstock is correct for level and height, the broad slips ı each side of the headstock require attention. These are set or level in the same way as the headstcok, by planing away, adding to, the wood packing. At this point attention should e paid to the packing of the bed plate and copping motion, ıd precautions should be taken to ensure that all holding-own bolts and screws are absolutely secure.

Setting the Roller Beam

The procedure usually followed in setting the roller beam as follows: A line is run from one out-end roller beam and, through the headstock, to the last roller beam stand on ıe opposite out-end, and this line is in the necks where the ont roller runs. It is tightened to the required tension. A ooden templet or magic is placed in each out-end stand under ıe line. A templet is made to fit in the neck of the front-ller stand. It is about 1½ in. high and has a groove exactly the center for the line to rest in. When these templets are position, the line is over what would be the center of the ont roller. At the headstock the line should hang clear and in the center of the bearings at each side where the front ller runs. If it is not so, then the roller beam must be oved at one end or the other to bring the line central. This fairly easy to do as there are slots in the out-ends for ljusting purposes.

Having got the out-ends lineable with the headstock, the

templets can be taken out. The line must then be tightened and smaller templets used in the out-ends, and one of these placed in the headstock stand. It is then possible to get each roller stand somewhere near central with the line, by moving the roller beam; the slots in the spring piece top are provided for this purpose. It is not necessary to get the stands dead true at this stage.

The next step is to bring the roller beam in its entire length to the same height as the headstock and out-ends. This can be done by sighting, treating each half of the mule separately. Three brackets can be secured to the roller beam, one at the out-end, one at the headstock, and the other in the middle of the half mule. By glancing along the roller beam from the out-end, it will be possible to see whether the central point requires raising or lowering. When this has been adjusted in each half, it can be considered that the main setting points are right. The templets can then be removed, and replaced with two folds of fairly thick paper. Each roller stand should then be got just clear of the line, by raising or lowering the roller beam by means of the spring pieces. When this has been done, the roller beam may be leveled crosswise at each spring piece. It is advisable to be extremely careful about this work if the best results are desired. The final lining-up consists of going over every stand on the roller beam, and moving it backwards or forwards until it is quite central with the line.

Replacing Front Spindle

It is now possible to replace the front spindle, and put on the front spindle pinion and catch-box, but before doing so it is advisable to examine these very carefully to see that they are in good condition, and have no broken teeth. On the squares of the front spindle and steel rollers there are numbers which indicate that a certain square must fit in a certain roller. When the front roller is being reassembled, it is advisable that the operator have these numbers in front of him so that no mistake will be made and each section will go back to its original position.

It is assumed that the brasses in the roller necks have been examined and renewed where necessary. When the front roller line is complete, the back and middle lines can be set up to the front line, the distance between them being regulated by the average length of the staple of the cotton that is to be worked. In actual practice the distance between the front and middle roller centers should be $\frac{3}{32}$ in. in excess of the average length of the cotton staple. This setting gives the greatest strength consistent with the quality of the cotton.

At this point the rollers should be oiled, after which the cap bars can be replaced and set to the required gauge.

The next operation is to see that the back shaft is resting

equally on all its bearings, and that all the keys in the couplings are secure and the scrolls in the right positions and properly keyed. The back-shaft catch-box should be examined and reset if necessary. At this stage the creels may be overhauled.

The Carriage Again

The carriage must be in a position half way on the outward run, with all the drawbands and headstock bands slack. It is first necessary to slacken about a dozen turns all the bottom nuts belonging to the carriage raising screws. The carriage may now be leveled over every slip by means of these raising screws, and to do this it is necessary to have the spirit level on top of the wood mountings inside the carriage.

At the same time the spindle points should be set somewhere near the right height at every slip. This is done by means of a gage about 4 ft. long, one end of which rests on the front steel roller, and the other end on the spindle points, but about ½ in. lower than the height of the front roller. A spirit level is placed on top of the gage and the back and front raising screws of the carriage are adjusted equally until the spirit level is correct.

If the carriage is much out for height, it will be necessary to go over each set of raising screws several times; because if the carriage is lifted much at one slip, it is going to affect the height at each side. Consequently it is only possible to overcome this by going over it several times.

Having got the carriage level, the diagonal rods which run the length of the carriage should be tightened. When doing this it is advisable to start at the headstock and work to the out-ends. The strong rods that hold the carriage together at the couplings—there are usually two sets of these in each half—should be well tightened. These things being done, the carriage is ready for stretching.

The Stretching Operation

To do this a line must be run along the back of the carriage from end to end, and must be made tight. Three wood gages, all exactly the same height, are required, and it is usual to treat one half of the carriage first. One gage is placed under the line at the out-end, another at the headstock, and the remaining gage is used to find if there is any clearance between the back of the carriage where the two couplings are, and the string.

Checking Clearance

If the clearance is excessive, the carriage must be brought

in at this point. To do this, the coupling will have to be packed with a suitable amount of paper strips in the tenoned joint at the back. To get the packing in, the coupling bolts and diagonal rods at this point must be slackened. After putting in the packing the joint must be tightened and the gage again tried. The operation must then be repeated in the remaining half of the mule.

When each half has been set, a gage must be placed at each out-end, and the remaining gage tried at the headstock to ascertain the clearance, or lack of it. It is better in actual practice to have the carriage about $\frac{1}{8}$ in. hollow at the headstock. This means that the carriage is to be $\frac{1}{8}$ in. away from the gage. This is advocated because, when the mule begins its inward run, all the pull is at the middle of the mule, owing to the force exerted by the back scroll bands. Thus, allowing the carriage to remain hollow counteracts this to a certain extent, and allows the carriage to remain in square longer.

At this point it is advisable to go over all nuts and bolts on diagonal rods, carriage couplings, etc. The spindle rail should be examined and broken bolsters renewed. Some superintendents take this opportunity of having the spindle bolsters and footsteps reamed. Doing this makes the mule run lighter.

Lining Up the Spindles

The next operation is to line up the spindles. This implies getting the spindles in a straight line from one end of the carriage to the other end, and putting in the correct amount of bevel at the same time.

The baywood ribs must first be removed and all faller-stand adjusting screws made quite free so that they will not interfere with the moving of the spindle bolster rail. The amount of spindle blade outside the bolster must be ascertained; and, assuming the amount is $7\frac{1}{2}$ in., a wood gage must be made $7\frac{1}{2}$ by 6 in. This gage will slide on the spindle rail, and must be placed in turn against the spindles over each stand supporting the fallers. These stands are adjustable on most types of mules; and, by altering stands where necessary, it will be possible to have the correct amount of spindle outside the bolster throughout the length of the mule.

As a preliminary to setting the spindles, it is necessary to obtain three wooden stays, each one to be the same length, about 4 ft. long. The object of these stays is to keep the carriage in a rigid position while spindle resetting is going on. One must be fixed at each end of the carriage. While these are on, the carriage is parallel with the roller beam. The amount of bevel that is to be put in the spindles must be known, and the spindle gage set from this. The amount of bevel or inclination introduced into the spindles is usually about

ıe in four for medium counts American cotton; that is, 4 in. ›r a 16-in. spindle. This varies according to the views of ose responsible for the mules.

The best way to obtain a setting for the gage is to fix a ›indle in the vise, and by means of a drop line and rule put in e required amount of bevel. Then put on the spindle a ıadrant gage, and this will indicate the amount of bevel esent. This quadrant gage may then be put on the spindles, ıd three boxes set to the bevel mark indicated previously. hese spindles having the correct bevel in them, the lining-up ge can be set to them. This setting will do for all the mules at follow, if the spindles are the same length and the bevel is be the same.

Having got the right bevel in three boxes of spindles at one d of the mule, three boxes may be set at the headstock, and ree at the other end of the mule. These three setting points able the operator to fix a spindle line about 6 in. above the indle points. It is suspended from two stays, one at each d of the carriage, and passes over the whole length of the ıle. The setting gage can then be placed on the spindles at e end of the mule. When the plum bob line is central on the le, the side of the rule should be $\frac{1}{32}$ in. clear of the line. ıis operation must be repeated at the other end of the mule. ıe headstock spindles may then be made correct. When this s been done, the remaining carriage stay may be put on, and s will hold the carriage quite rigid.

Procedure Illustrated

Fig. 1 shows a spindle-setting gage. Fig. 2 shows the gage position on the spindles. The two carriage stay rods *A* and shown in Fig. 2 control the position of the spindle. Two jects are desired in setting the spindles: the correct amount bevel must be introduced, each spindle must be the same dis- ıce from the nip of the rollers. When the plum bob *D* central on the rule *E*, the proper amount of bevel is present. To get the spindles right for distance from the nip of the lers, the carriage stays must be adjusted until the rule *E* $\frac{1}{32}$ in. from the line. This operation is very important, and it ıst be remembered that two objects are desired: the correct ount of level, and the right distance from the nip of the lers. It is usual to go over a mule three times in this nner.

The baywood ribs may now be replaced, and between these l the spindle warves there should be a clearance of $\frac{1}{16}$ in. e tin-roller shaft in the square may then be overhauled, l any broken click wheels replaced. Clicks and click springs st be examined—also the tin-roller shaft bearings. The -roller pulley key must be quite secure.

When setting this shaft, a tin roller should be placed on at

each side of the square, and tightened with the blocks close to the pedestals, leaving $\frac{1}{32}$ in. side play in the shaft and at the same time leaving a little side play in the winding pinion and the backing-off click plate wheel.

To set the tin rollers the gage shown in Fig. 3 is used, and the setting point is obtained at the headstock. The gage is placed with its large end against the spindle feet inside the carriage. The other end is adjusted until the point when

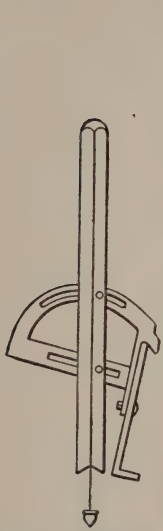


Fig. 1. Spindle Setting Gage

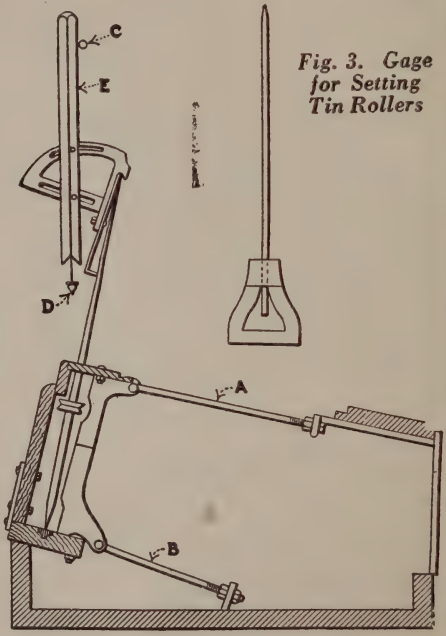


Fig. 2. Gage in Position on Spindle

Fig. 3. Gage for Setting Tin Rollers

moved up and down just touches the tin roller. The same procedure is carried out at each tin roller, and the end tin rollers must be set for height as well as distance.

Re-Stringing Operation

The mule is then ready for re-stringing, and this must be done by some competent person who will put on the spindle bands at the correct tension. At the same time all the tin-rolled oil tubes may be cleaned. The top and back carriage

boards can then be put on, and sometimes these require some alteration before they will fit. Often it is necessary to repair some of these.

The next operation is to set the faller shafts for correct height and distance in relation to the spindles. The faller shafts should be set so that the faller wire, when at its lowest point—that is, when the sickles are touching the spindle rail—is $\frac{1}{8}$ in. clear of the spindles. When the sickles are pulled back and the wire is level with the spindle points, it should be $\frac{3}{16}$ in. away from these. It is advisable to adjust one length of shaft until the desired clearance is obtained, and then the gage may be set to that length and this setting will do for the whole mule. It is essential that the shafts rest in the bearings of the faller stands, and the faller caps should not bind in any way. It is important that these shafts work quite freely; otherwise ridgy cops will be made. All coupling keys must be tested and made secure.

It is advisable at this point to regulate the tension of the wire, and replace with new any length that contains piecings. When the shafts have been set, each sickle must be examined and made straight and the correct radius from the faller shaft. This can be done with a pointer which has been set from a cast-iron finger at the end of the faller shaft. When this has been done the sector can be set in the correct position in relation to the faller wire. In the case of a Platt Brothers mule, there is a planed portion on top of the sector, and the sector should be in such a position that the planed portion is perfectly level, and keyed in this position. The winding faller finger at the headstock must be set $1\frac{1}{4}$ in. above the spindle point, and the others at the same height.

With the sector and winding faller in these positions, the faller stops can be set—also the half moons belonging to the plunge weights, and all of the faller springs.

The fallers can then be locked and unlocked to make sure that they work freely. Salmon-head levers can then be hooked on the faller connecting chains. These levers are centered under the carriage, and the front end of the lever should be slightly higher than the back end when the fallers are in the spinning position. The counter faller wire can then be fixed at the correct distance below the spindle point. This distance is usually $\frac{5}{8}$ in. With the counter faller in this position, the half moons and chains may be set. All the chains must be the proper length so that the half moons come in the correct position when they are tightened.

It is now necessary to set the winding faller sickles in the winding position, and for this purpose a gage having an adjustable leg is used. This fits on the spindle point and the leg is near the spindle rail. Each sickle must rest on this leg. It is also necessary to set these when yarn is on the spindles.

General Details

The next step is to have the backing-off plate wheel in the proper position, and on a Platt Brothers mule this is with the oil holes to the top, or slightly to the back. The backing-off chain may then be connected to the sector.

It is usual at this point to go through the setting of each motion in the headstock, renewing any parts that are worn,

Fig. 4 Topping Gage in Position

and replacing bad friction leathers. When this has been done, all bands can be put on and tightened to the required tension. The carriage stays can now be taken off.

All back stops can be examined and fastened securely to the floor, and buffers loosened and moved back. The carriage can then be drawn under the roller beam for "topping."

The object of this operation is to have the spindle points the same distance from and below the front roller. Fig. 4 shows the gage in position. For counts up to 40s the spindle point is $2\frac{3}{4}$ in. below and $2\frac{1}{2}$ in. away from the front roller. It is necessary to get the first setting point at the headstock and adjust the gage until the plumb bob is straight. The spindle point should just touch the block. If it is too high, or too

low, its position may be altered by means of the carriage raising screws, care being taken that the back and front are altered the same number of turns. If this is done, the bevel of the spindles will not be altered. The back stops can then be set up to the carriage, and the carriage wedged in that position. All raising-screw nuts can then be finally tightened.

The length of stretch, relieving lever bowls, change for long lever, counter faller depressing finger, and unlocking bracket can then be set.

While the mule is in this position, it is advisable to examine the copping rail and plates. If the plates have been filed they should be brought back to the right shape by filing to a templet. The shaper screw should be in good condition, also all studs and bowls. If there are flats on these bowls, there is trouble with winding, and ridgy cops are made. The copping rail and plates must be set for the full size of cop to be spun, and the copping bowl in the right position on the end of the copping rail.

The draw bands can now be tightened—they should have been slackeed while "topping" was being done—and the carriage-holding wedges removed. Then the mule can be drawn on the head. The holding-out catch should drop on stud. The long lever change can be set—also inclines for relieving counter faller during backing-off. The setting of these depends on the counts to be spun. The cam can then be changed. The backing-off friction should have hold and the taking-in friction be clear. The fallers can be locked by hand; the backing-off friction should be clear and the taking-in friction ready for work. While the mule is in this position, the quadrant should be fixed in the correct position. The back shaft should be in such a position that the keys in the band scrolls are on top center. The mule can then be pulled up to the roller beam.

A thorough methodical oiling should now take place, and then the mule is ready for running.

It is advisable to put the drag wheel out of gear and run the rollers only for a time. After this the mule can be run in and out and any small adjustments made. The mule is then ready for spinning.

ANALYZING FANCY COTTON FABRIC FOR PURPOSES OF REPRODUCTION

By Clarence Taggart

Although the reproduction of cloth from woven samples is common and every-day work for the mill designer or weaving overseer, there are so many different cloths that it is hard to say which system of analysis is the best to follow. Of course every mill has some individual peculiarity or condition which necessitates a system different from that of other mills, but the system explained herein is very simple and could be applied under almost any conditions.

In the average mill, swatches are received daily on which it is required that costs be determined and samples be woven. A simple and comprehensive system is necessary. Any system if followed daily will become a habit, and therefore a good sound system should be practiced as early as possible.

Procedure Advised

Upon receiving a piece of cloth for analysis, the following procedure is advisable:

1. Determine as near as possible ground sley and pick.
2. Count the number of ends in each stripe, beginning with the largest ground stripe and working from right to left until a full repeat of the pattern is covered.
3. Decide on what sley reed is to be used.
4. Find number of dents each stripe occupies.
5. Prove layout plan.
6. Find the number of patterns in the width of the cloth.
7. Rearrange the layout plan to indicate start and finish for drawing-in.
8. Figure the total ends of each different warp and total number of dents required.
9. If necessary, pick out details of weave.
10. Put harness numbers under details of weave.
11. Make drawing-in draft.
12. Select from harness draft the numbers which are to cut.
13. Make chain draft and be sure every harness cuts.
14. Figure the number of heddles for each shaft.
15. Figure weight of each material, percentage of each material, and yards per pound.

Illustrative Example

To correctly illustrate the system, complete analysis of the piece of cloth illustrated in Figs. 1 and 2, is described.

1. The ground sley is 72x60. The sley in unequally reeded fabrics can be determined by measuring the stripes by a 100ths rule, multiplying the number of ends counted by 100, and dividing the result by the number of 1/100th parts they measure. The number obtained is the sley.

2. Number of ends in stripes:

18 Gray	18 Gray
3 Rayon and 2 Gray	4 Gray
6 Gray	4 Gray
5 Color and 4 Gray	4 Color and 4 Gray
6 Gray	4 Gray
3 Rayon and 2 Gray	4 Gray

3. Sley reed: The cloth width of 36 in. x 72 sley equals 2592 ends. Reed width equals 36 in. plus 7% for contraction, or 38.50 in. The total ends, 2592, divided by 2 ends per dent equals 1296 dents. 1296 dents divided by 38.50 in. equals 33.66 dents per inch.

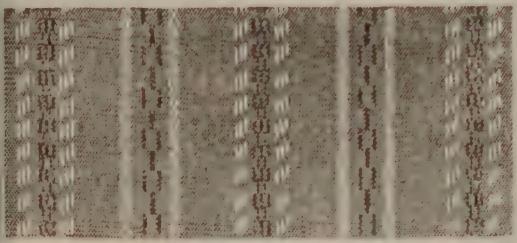


Fig. 1. Fabric Analyzed

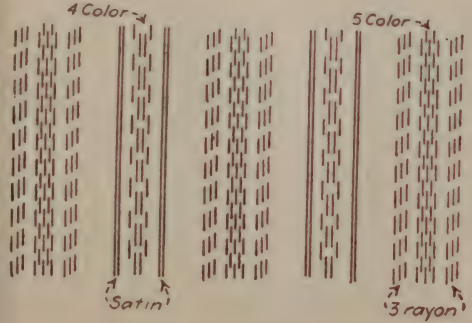


Fig. 2. Sketch of Stripes

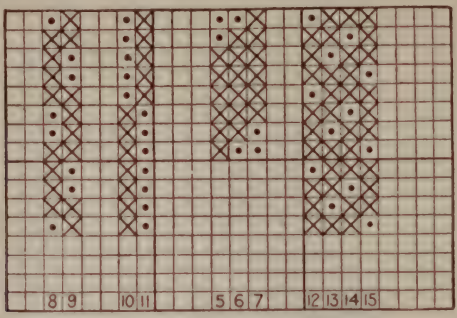


Fig. 3. Details of Weave

(*For figure 4—see page 46*)

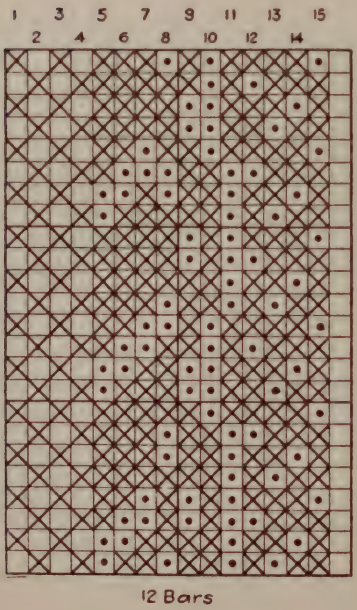


Fig. 5. Chain Draft

4. Number of dents each stripe occupies:

Rayon	Color	Gray	Dents
..	..	18	9
3	..	2	1
..	..	6	3
..	5	4	2
..	..	6	3
3	..	2	1
..	..	18	9
..	..	4	1
..	..	4	2
..	4	4	2
..	..	4	2
..	..	4	1
6	9	76	36

The number of dents a stripe occupies can also be determined by the 100ths rule.

5. Prove layout plan: The layout plan shows the numbers of ends and the dents occupied (see 4). To prove, count the full number of ends in one pattern of each different yarn in the cloth and compare with the totals in the layout plan. Measure the width of one pattern and compare with the total number of dents in the layout plan.

6. Number of patterns in cloth width: 1296 dents less 16 dents for the selvage equals 1280 dents. 1280 divided by 36 dents in one pattern equals 35 full patterns and 20 dents over.

7. Rearrange layout plan to indicate start and finish for drawing-in.

Rayon	Color	Gray	Dents
..	..	12	6
..	..	4	1
..	..	4	2
..	4	4	2
..	..	4	2
..	..	4	1
..	..	12	6
..	..	6	3
3	..	2	1
..	..	6	3
..	5	4	2
..	..	6	3
3	..	2	1
..	..	6	3
6	9	76	36

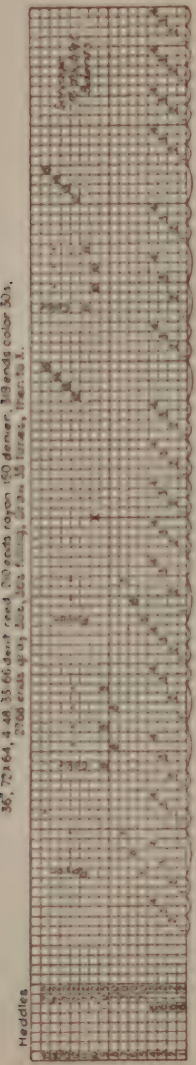

Heddles
36, 72x64, 4 48 35 66 dent reed, 2 ends rayon 150 denier, 1 end cotton 30s,
2768 ends per dy. Jute, Jute Linsey, Warp 35 inches, Weft to X.

Fig. 4. Drawing-In Draft

This is rearranged to make the drawing-in simple and to obtain the same width of stripe next to each selvage.

8. Total number of ends and dents:

Rayon	Color	Gray	Dents
6	9	76	36 (one pattern)
..	..	..	35 (full patterns)
210	315	2660	1260
...	4	44	20*
...	...	64	16†
210	319	2768	1296

*(1st 20 dents in layout plan)
†(Selvages)

9 and 10. Details of Weave: See Fig. 3.

11. Drawing-in draft: See Fig. 4.

12. Select cutting numbers: 1 and 15, 12 and 4.

13. Make chain draft: The nature of the weave does not allow the colored or rayon stripes to cut. The satin strip is made to cut on both sides. See Fig. 5.

14. Number of Heddles:

15	72
14	72
13	72
12	72
11	72
10	72
9	105
8	70
7	70
6	70
5	70
4	612
3	612
2	612
1	612

This is obtained by multiplying the number of eyes necessary in each pattern by the number of patterns plus the number of heddles required for the 20 dents, and 16 heddles for each selvage.

15. Weight and percentage of each material per 100 yd., and yards per pound of total:

Rayon: 210 ends x 105 (5% contraction) / 840x35s (The rayon is 150 denier, which is equal to 35s cotton).	.75 lb.	3½%
Color 319 ends x 107 / 840x30	1.35 lb.	6 %
Gray: 2768 ends x 110 / 840x30	12.08 lb.	54½%
Dents: 36 in. wide x 64 picks x 107 / 840x36s	8.15 lb.	36½%
	22.33 lb. yarn in 100 yd.	

100 yd. ÷ 22.33 = 4.48 yd. per pound.

MOISTURE PENETRATION OF COTTON YARN ON FILLING BOBBINS

By J. H. Whetmore

In cotton mills it is usually found that filling from the spinning frame contains from 5 to 7% regain, and that if it is taken directly to the loom, more or less trouble in weaving is bound to develop, due to "untamed" twist in the yarn. The extent of the trouble depends more or less upon the amount of twist put in the yarn, and varies directly with the degree of twist.

In conquering this "untamed" twist two factors are necessary—time, and additional moisture. During the operation of spinning, the fibers are forced into an unnatural position, and until we get accustomed to this new position the yarn will kink. Time is an element which affects the condition, because any bobbin of yarn which has been lying around for a long time, even in a dry place, will have lost its tendency to kink, and the yarn on the bobbin will feel soft and dead. Moisture must be a good combatant, because yarn is generally conditioned to remove kink. Time alone is too slow, so moisture is used to speed up the conditioning. If this moisture is warm, the results are quicker and better; in fact, steam is the element used in most so-called conditioning machines.

How fast will yarn absorb moisture if allowed to stand in an atmosphere of high relative humidity? Does the position

of the yarn in the box make any difference? Does penetration differ in the outer layers of the bobbin and the inner layers?

To get at the answers to some of these questions the following test was devised: Three boxes of yarn were taken directly from the spinning frame and placed in one corner of the weave room, where slightly higher conditions of relative humidity could be maintained than was ordinarily the case. A machine was devised so that one-third of the layers of a bobbin could be cut off, then another one-third of the layers cut off, and finally the last one-third or innermost layers. As rapidly as

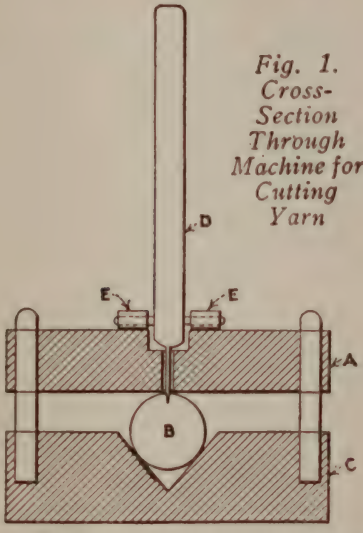


Fig. 1. Cross-Section Through Machine for Cutting Yarn

the layers were cut off they were sealed in glass jars to await the baking-out process to determine regain. In this way penetration could be observed. To gather further data bobbins were taken from the top of the boxes and also from the bottom of the boxes. About every six hours the yarn samples were taken, and also the humidity readings. At each reading a bobbin from each box, top and bottom, was cut to obtain an average.

Fig. 1 shows a cross section through the machine for cutting yarn. In operating this device the top board *A* is raised to allow the bobbin *B* to be inserted in the V-slot in bottom board *C*. The cutting knife *D* is then inserted in the slot in the top board and pushed back and forth parallel to the axis of the bobbin. The rollers *E* keep the knife edge at a constant depth. The bobbin is then removed, and the outer layers of

yarn which have been cut can be removed easily. The bobbin is then inserted in another set of boards with the V-slot not so deep, so that the knife will cut off another third of the yarn. This operation is again repeated on a third set of boards to get the innermost layers of yarn. Fig. 2 shows a sectional view of the bobbin, showing the position of yarn cut from the bobbin; *A* indicates the outer layers, *B* the middle layers, and *C* the innermost layers. Fig. 3 is a chart presenting in graphical form the data obtained in this investigation.

A study of the chart leads to the following conclusions:

1. The bobbins at the bottom of the box absorb moisture much more slowly than those on top, this being due to their protected position, in contrast to the exposed position of the bobbins on top of the box. In fact, by looking at the chart it can be seen that at the end of a week's time the bobbins at the bottom of the box had not picked up as much moisture as those on top did in 18 hours.

2. If moisture is taken on rapidly by the yarn on a bobbin, the regain throughout the bobbin will not be as uniform as is the case where the moisture is absorbed slowly. A study of the curves brings out this conclusion very plainly, for at the beginning of the absorption process the outer layers of the bobbins take on the moisture noticeably faster than inner layers. However, in studying the curves for bobbins at the bottom of the box this is not the case, due no doubt to the fact that the moisture is taken on so slowly.

3. Yarn standing in boxes cannot be uniformly conditioned, even though boxes have holes bored in them as was the case in this test and even though a fairly high relative humidity is maintained about the box.

Fig. 2. Sectional View of Bobbin Showing Position of Yarn Cut from Bobbin

4. In order to insure uniform moisture content throughout the bobbin, yarn should be allowed to stand some time before being woven even after the conditioning process is complete.

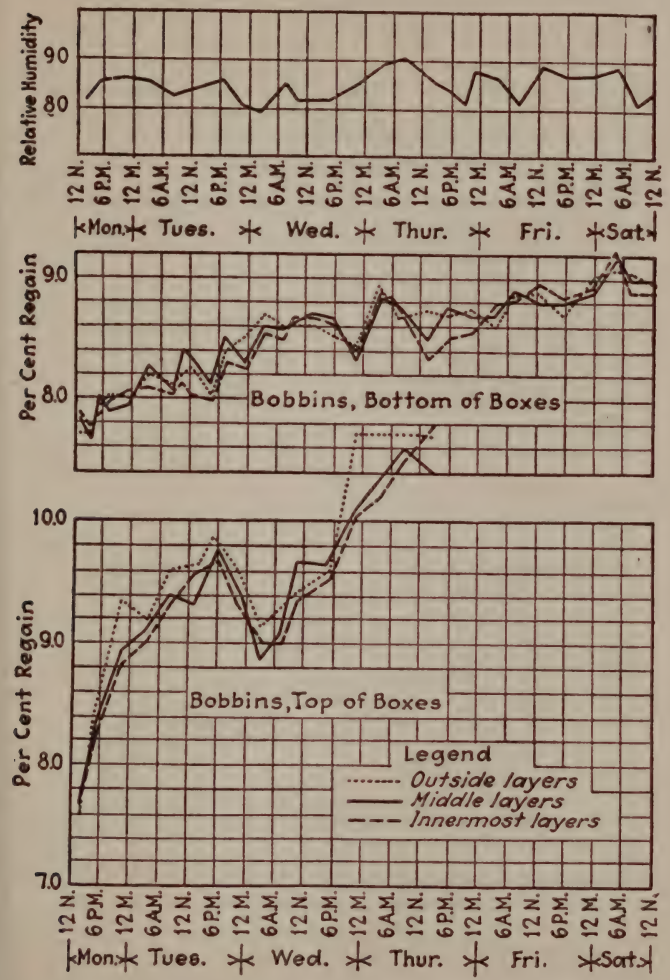

Relative Humidity
9.0
8.0
12 N. 6 P.M. 12 M. 6 A.M. 12 N. 6 P.M. 12 M. 6 A.M. 12 N. 6 P.M. 12 M. 6 A.M. 12 N. 6 P.M. 12 M. 6 A.M. 12 N. 6 P.M. 12 M. 6 A.M. 12 N.
Mon. Tues. Wed. Thur. Fri. Sat.
Per Cent Regain
9.0
8.0
Bobbins, Bottom of Boxes
Per Cent Regain
10.0
9.0
8.0
7.0
Bobbins, Top of Boxes
Legend
Outside layers
Middle layers
Innermost layers
12 N. 6 P.M. 12 M. 6 A.M. 12 N. 6 P.M. 12 M. 6 A.M. 12 N. 6 P.M. 12 M. 6 A.M. 12 N. 6 P.M. 12 M. 6 A.M. 12 N. 6 P.M. 12 M. 6 A.M. 12 N.
Mon. Tues. Wed. Thur. Fri. Sat.

Fig. 3. Time required for Moisture Penetration of Cotton Yarn on Filling Bobbins

TINTING YARN ON BOBBINS

Technical Editor:

We are interested to know whether you could advise us of an inexpensive method of tinting crepe-twist cotton on spinning bobbins with a fugitive dye. We do considerable of this work at the mill but find it quite expensive to handle, and if you can forward us any data, together with figures, we would appreciate it. (6953)

To get any solution of a dye or tint in water to penetrate a wound bobbin, especially when the yarn is a hard crepe twist would be almost an impossibility. There is a method, however, by which this may be accomplished. Select for the tints a series of acid dyes which have no affinity for cotton and which are partly soluble in alcohol. Soak the bobbins for an hour or more in the alcohol solution and the color will penetrate evenly to the very center, as well as into the hard twist of the yarn. Drain well or hydro-extract and dry at a gentle heat, avoiding lights or fire.

As an example of a dyestuff which should be well adapted for use in this way we suggest Patent Blue A. This has a good solubility in alcohol and will readily scour out of cotton in an alkaline bath. Fast Red A is soluble in alcohol but would tend to stain cotton more or less, hence some experimenting will be necessary to get a complete line of tints. You cannot expect any sort of tint to discharge by a simple wash; it will always require a good boil and a fair amount of soap and soda to get tinted cotton clean again. Some dyers use either hydrosulphite or a little hypochlorite bleaching liquor to get a good white.

SIZING FOR DENIM WARPS

Technical Editor:

Will you please give us a good sizing formula for sizing denim warps? In the Southern States they seem to get a heavier size on their warps than we do, and it gives the cloth a much firmer feel. Do you know what their sizing formula is? We would appreciate it if you would let us know. (6937)

Two formulas used by southern mills for denim warps are given herewith. While they may have to be modified to suit certain conditions and kinds of water, both will give excellent results. Formula No. 2 is used by mills that manufacture their own denims into overalls. No. 1 formula is used by a mill for coverts, denims, and automobile seat covers. This mill turns out a very high-grade product.

Formula No. 1

Eagle starch No. 2	160 lb.
Good tallow	12 lb.
Gum tragacanth	1 lb.
Glycerine	5 lb.
Water	160 gal.

Boil not less than one hour.

Formula No. 2

Eagle starch No. 2	300 lb.
Tallow	21 lb.
Gum tragacanth	1½ lb.
Water	320 gal.

Boil one hour.

The manufacturers of sizing materials advertising in TEXTILE WORLD will be glad to give you other formulas and can work out anything you need.

FINISH FOR COTTON TWINE

Technical Editor:

I am enclosing herewith small sample of glazed, polished cotton twine. We manufacture the raw twine and desire to duplicate this finish. Can you give me the formula for this process? (6936)

While the sample has been dyed in the regular manner, a large amount of this class of goods is dyed while it is being glazed. Tufting and roll edge twines are examples. In fact, almost all manufacturers of this class of goods are using this method of dyeing. The following formula will duplicate the finish of the sample: 20 lb. corn starch; 5 lb. tapioca flour; 2½ lb. beeswax; 3 lb. carnauba wax. The carnauba wax must be saponified before adding to the rest of the mixture. This formula will make 50 gal. of starch.

COTTON SPUN ON WOOLEN SYSTEM

Technical Editor:

I would like to get information on the following questions: How fine a yarn can straight cotton be made into on the woolen principle and be practical? How fine on ring doffers? How fine on tape condensers? What kind of cotton are best for such a purpose? (6783)

It is difficult to give definite answers to questions of this type. Almost any statement would have to be limited by various conditions involved, and a great deal would depend on the type of yarn to be made.

To answer the question generally, we would say that about 8s cotton count is as fine as is practical on the woolen system. We do, however, know of cases where yarn has been spun as fine as 12s commercially for special purposes.

On a ring doffer about 5s is as far as you can go. With tape condensers you can go to 8s. A good clean cotton of 1-in. staple will run just as well on either a ring doffer or tape condenser as $1\frac{3}{16}$-in. As a matter of fact, suppose you are going to make 8s, you can mix in a percentage of fairly good clean strips and get just as good results as you would for straight cotton. This answers your questions in a general way.

To enlarge a little on the subject. If a mill intended making 6s, 7s, 8s, 9s, or 10s cotton yarn, and a very strong, even thread were required, the woolen system would not be as practical as the cotton system. But for yarns to be used for backing purposes or napped blankets, the woolen system is much better as the yarn naps better and fuller than yarn made on the cotton system.

As regards cost, the woolen system does not take out as much waste, which is a direct saving. However, woolen equipment is expensive and an investment on the woolen system, based on production, is really higher than on the cotton system. In the matter of labor, in spite of the fact that material goes from cards directly to spinning on the woolen system, labor seems to be somewhat higher than on the cotton system.

WOOLEN & WORSTED SECTION

ELIMINATING FAULT MAKERS IN WOOLEN SPINNING

By Richard Jackson

To understand the self-acting mule perfectly requires practical experience over a prolonged period, and calls also for contact with the various materials which are used, and with the varying conditions which exist. Understanding cannot be complete without experience in the spinning of a variety of counts. With this knowledge acquired, it is possible to meet every problem and difficulty with a trained mind, aided by diligent study and experiment. Even a trained mule spinner must be prepared to violate at times laws that he may have formerly considered inviolable. This applies particularly to problems relating to drafting, as it is at this point that the thread is actually made. If too little twist is inserted during this period, an uneven yarn results; while if the twist is excessive, ends break down, entailing much piecing, waste making, bad yarn, and other attendant evils.

It is practically impossible to produce roping at the condenser which is exactly equal in volume throughout its entire length. This being so, it is the duty of the spinner to level up these inequalities, a result accomplished by regulating the amount of twist imposed during the drawing operation. As drafting takes place the twist runs into the smallest places first and binds the fiber so tightly together than further drafting is resisted at these points. The thicker portions of the rovings with less twist are now drafted down until levelness in diameter and uniformity in volume are established throughout the length of yarn between the delivery rollers and the spindle tops.

Although rules for twisting during drafting may be given,

they are of suggestive or approximate value only, as the correct amount varies greatly with the count and the length and diameter of the material forming the blend. Finer counts require more drafting than heavy counts, but a good practical knowledge is necessary to decide the best amount. A good spinner can always tell by touching the yarn whether the drawing is being done in the best manner. Any required alteration will be made by changing the speed at which the carriage travels away from the rollers during drafting. If more twist is required throughout the draw, the pinion wheel which controls the carriage will be replaced by a smaller one, which has the effect of drawing the carriage slower and allowing more twist to go into each inch of yarn. Another method of altering the amount of twist during drafting is by changing the slow-speed rim on the headstock, a smaller rim reducing the speed of the spindles and incidentally the amount of twist inserted in the yarn.

Occasionally the yarn draws correctly until just before the carriage reaches the end of the stretch, when the threads become too tight and break down under the strain. The fault is commonly caused by the delivery being too short and may usually be remedied by moving the carriage scrolls slightly backward. The scrolls which draw the carriage out are so made that the speed of the carriage is gradually decreased from the time it reaches about half-way until the end of the draw. By moving them slightly backward and forward the threads can be drawn tighter or slacker, as desired. At the end of the draw, the threads should be fairly tight, with the fibers set closely, and any further drafting made almost impossible; after which it is only necessary to insert the remaining twist at a faster speed to produce a strong and even thread.

It is very important that the amount of twist throughout the length of yarn be equal, as any unevenness will show in the finished cloth, the tighter-twisted portions appearing darker in the finished piece. No definite rule as to the amount of twist for any given count can be laid down, as other important factors must be taken into account. Warp yarns should be given as much twist as possible, however, without making them hard and brittle. An average 4-run yarn should have about 17 turns per inch to give the best results. During the twisting of the yarn the jacking-in motion should be used to the best advantage by keeping the threads fairly tight during the inward motion of the carriage.

Care must be exercised to avoid the drafting of the slubbing before the delivery rollers cease to revolve, as this results in uneven yarn. Uneven drafting may occur at two points; viz., (1) between the condenser spools and the delivery rollers, and (2) between the delivery rollers and the spindles. The former is caused by the drums carrying the spools revolving too slowly. As the slubbing is in its loose, open condition, any

unevenness coming from the condenser will be increased. Occasionally the spools give off the roving ends slacker at one point than at others; this is because the condenser rubbers are badly worn or badly set, and the only remedy the spinners can apply is to reduce the surface speed of the spool drums slightly. This produces the proper tension in the slack ends but tends to produce uneven threads by drafting the others slightly.

Uneven drafting is caused at the second point by the carriage traveling away from the rollers faster than the roving is delivered. This is a much greater evil than the former, and all mules admit of correction in this respect. The carriage must travel faster for a long-length delivery than a short one, because in the latter case the rollers will overrun the carriage towards the end of the delivery on account of the band getting down on the lower part of the scroll. If this defect is allowed, a short length of soft slubbing wraps around the spindle tops, getting neither draft nor twist.

Sometimes yarn may be found with a great many small places in it, caused by (1) badly condensed slubbing; (2) slack drawing (i.e., insufficient twist inserted during drafting); (3) slubbing condensed too small in relation to the spun count; (4) slack rim band, causing the spindles to vary somewhat in speed on account of the band slipping at intervals; (5) slack spindle bands, in which case individual threads would show the defect; (6) bad piecings or tyings of broken ends.

Sometimes the minders will place the broken slubbing on the spindle top as the carriage leaves the rollers; and, immediately after the delivery stops, they piece up the end, drawing a considerable length of spun yarn from the cops to join it. This results in a length of thicker yarn, as the delivered portion receives no drafting. The correct method is to place the end on the spindle top as the carriage commences its outward run, allow it to remain until drafting is completed, and then quickly piece it up or tie it as the twist is being inserted.

Uneven yarn may be caused by allowing the cops to become too full on the spindles; because when the top of the cop is near the point of the spindle, a length of spun yarn tends to slip off, thus giving less draft to this length delivered and producing thick threads. Another cause of uneven yarn is careless starting up of a new set of cops; because, if the whole length of spun thread is not wound on to the cop, any slack tends will slip back during drafting and produce thick threads or "snarls." Another cause is overfull spools made on the condenser, as the threads in such cases do not unwind at a steady rate. To avoid uneven twist, keep the rim and spindle bands in good condition; otherwise there will be slipping, which results in irregular loss of twist.

WHEN SHADY CLOTH CONFRONTS THE WOOLEN OR WORSTED MANUFACTURER

By B. F. Hayes

The problem of shady cloth is one of the most serious that confront the woolen or worsted manufacturer. There are various forms of this defect, and the first one that comes to mind is varying shade from side to center. The dyer is often blamed for this defect, but a careful study of the problem exonerates him.

It is often a very difficult problem to determine the cause for shadiness from side to center, and men have different ideas on the subject. One acquaintance of mine, who has given the matter much study, believes that the cause lies in the natural affinity of the cloth for moisture. He explains that the pressing operation in the finishing department takes away the natural moisture in the cloth, and after the cloth is rolled up the outer edges will take on moisture more quickly than will the center of the fabric. The remedy which he offers for this difficulty is to pass the cloth through a conditioning machine following the pressing.

Other Causes

Although my friend's reasoning may solve the problem in certain instances, there are other causes beside uneven absorption of moisture. Some mills attempt to overcome shadiness from side to center by giving the selvages a slacker weave than is employed in the main body of the cloth, or by using a stock for the selvages which does not have as high fulling qualities as that used for the warp. The theory behind these remedies is that outside edges will full more quickly if the same weave and stock are used as in the warp, thus giving the cloth a firmer body on the edges. Although this greater firmness of the cloth at the edges may not be sufficient to attract immediate notice, it is nevertheless very likely to cause the defect. This is especially true on light or medium shades. It would probably not be the cause of the defect on dark shades.

There are times when the cloth is shady on one side only. In this case the trouble is very likely caused by the temple or shuttle. Temples are adjustable to all requirements and, like all adjustable parts of any machine, they are not always set properly. One temple may be pulling the cloth to the limit, and another may be so adjusted that the cloth simply slips through. Very possibly the defect resulting from such conditions would not be noticed until after the cloth is dyed and finished.

One cause of shadiness on one side of the cloth may lie in the location of the eye of the shuttle. Since this eye is necessarily near the end of the shuttle, it follows that as the shuttle starts from one side of the loom the filling becomes tight immediately, and as it starts from the other side the filling has more slack to take up before becoming taut. This circumstance would never cause any defect if an excessive amount of drag—preventing the filling from coming out of the shuttle freely—were never used.

Another cause for shadiness at one or both sides is the occasional improper placing of a covering on the cloth roll. The weaver should never be allowed to place such a covering at only one or both sides of the roll, as such a practice gives the cloth a larger take up of the sides than at the center. Although in this case, as in other instances previously mentioned, no defect might be immediately observed on the cloth, it would be very likely to show up after dyeing and finishing.

Cloudy Cloth

Cloudy cloth, sometimes also known as "shady cloth," is an entirely different defect from that which we have been discussing thus far. This might be caused in the dyeing or by the cloth not being properly scoured or rinsed. I recall one instance in which increasing the temperature of the water in rinsing solved the problem. There are times when crabbing in the crease will set the foreign matter in the cloth so firmly that excessive scouring must be applied to remove it and an excessive amount of soap must be used. This excessive soap is very likely to be the cause of cloudy cloth if it is not thoroughly rinsed out.

Shadiness in straight lines, running either across the cloth from side to side or running lengthwise, is usually correctly laid to mixing filling or uneven weaving. I would like to mention one instance, however, in which a defect of this nature was not due to these familiar causes. The cloth in question was a worsted of about 14 oz. in weight. The warp was mostly white when woven, but there were fancy resist-dye colors every one-half inch or so. When the cloth was finished, it was found that, beginning about 15 yd. from the end of one cut, the resist colors had taken on dye for about 1 yd. Following this defect the cloth was satisfactory for a short distance, after which the resist colors had again taken on dye.

The finishers claimed that the yarns must have been different or they would not have behaved in this manner. I explained to them that, if the yarns were different, there would be knots in the warp threads at the beginning and end of each colored portion, showing that two different threads had been joined together at such places. Investigation showed that there were no knots. The real cause of the defects, as finally determined,

was an excessive amount of crabbing, which had opened the pores of the wood and caused the fiber to take on dye. This was an instance in which, if the defective colors had run from side to side instead of lengthwise, mixed filling would have been blamed for the defect. We could not blame it on mixed warp because it would have been utterly impossible to cause changes in continuous threads by any manner of mixing.

Sometimes our warps are not dressed properly, with the result that they contain high or low sections. The unevenness resulting from such circumstances may be so slight as not to be noticeable until after the cloth is dyed and finished.

FORMULA FOR TWIST CURVES WHICH SHOW REQUIRED FRONT-ROLL SPEED

By Morris C. Bishop

The determination of the twist gears required to give a specified twist is not readily calculable and is seldom understood sufficiently by the average overseer to be calculated by him. The usual method of securing the desired twist is by "trial and error" or by selecting the gears from records of past performance. Such methods often cause costly delays and can be eliminated by setting up twist curves for the equipment in the mill similar to those shown on the chart below.

The relation of the lineal delivery rate of the front roll and the rotational speed of the balloon determines the twist, and may be represented thus:

$$\text{Twist turns per inch} = \frac{\text{Rev. per minute of balloon}}{\text{Inch delivery rate of front roll}}$$

As has been described recently in TEXTILE WORLD (Jan. 4, p. 54, and April 19, p. 22), this formula is not strictly accurate, due to the traverse motion of the ring rail. However, the variations are small and the relation as shown gives the mean of these variations.

In all machines the front-roll speed is a constant from the empty to the full bobbin. In flyer frames the balloon speed is constant, but in ring and cap machines the balloon speed varies from the empty to the full bobbin.

The delivery rate may be calculated thus:

$$\text{Delivery rate} = 3.1416 \times \text{Roll dia.} \times \text{R.p.m. of roll.}$$

The calculation of the balloon speed is a more complicated matter and will be explained as follows:

The rotation bobbin tends to keep the balloon rotating with it, but at a slightly slower speed. This lag is equal to the revolutions per minute that the balloon would have to make to wind the yarn onto the bobbin if that bobbin were stationary.

In this manner the balloon serves the double purpose of twisting the stock and winding the yarn onto the bobbin. This lag may be calculated as follows:

$$\text{Lag} = \frac{3.1416 \times \text{Roll dia.} \times \text{R.p.m. of roll}}{3.1416 \times \text{Dia. of yarn on bobbin}} = \frac{\text{Roll dia.} \times \text{R.p.m. of roll}}{\text{Dia. of yarn on bobbin}}$$

This considers the thread in terms of its untwisted length. However, turns per inch are expressed in terms of the twisted thread, which contracts while being twisted. It therefore becomes necessary to consider contraction in the calculations. Let V be the contraction factor.

$$V = \frac{\text{Untwisted length}}{\text{Twisted length}} \text{ or } = 1 + \frac{\text{Per cent contraction}}{100}$$

Formula for Twist

The complete expression for twist may be assembled thus:

$$\text{Twist} = \frac{V\text{R.p.m. of spindle} - \left[\frac{\text{Dia. roll} \times \text{R.p.m. roll}}{\text{Dia. of yarn on bobbin}}\right]}{3.1416 \times \text{roll dia.} \times \text{R.p.m. of front roll}}$$

This formula may be expressed more briefly by letting:

$R.p.m.s$ = R.p.m. of the spindle.
$R.p.m.r$ = R.p.m. of the front roll.
Ds = Diameter of the yarn on the bobbin.
Dr = Diameter of the front roll.

$$V = \frac{\text{Untwisted length}}{\text{Twisted length}}$$

Then the formula may be written thus:

$$\text{Twist turns per inch} = \frac{V\ [R.p.m.s - (Dr \times R.p.m.r \div Ds)]}{3.1416 \times Dr \times R.p.m.r}$$

A better arrangement of the formula is:

$$\text{Twist} = V\left[\frac{R.p.m.s}{3.1416 \times Dr \times R.p.m.r} - \frac{1}{3.1416 \times Ds}\right] = V\left[\frac{R.p.m.s}{3.1416 \times Dr \times R.p.m.r} - \frac{.318}{Ds}\right]$$

From this arrangement it is obvious that the difference in twist turns per inch from the empty to the full bobbin is equal to the difference between the respective reciprocals of the circumferences.

To illustrate the practical application of the formula, the accompanying chart has been drawn up to represent typical curves for a twisting frame.

The values selected are:

$R.p.m.s$ = 6,000
$R.p.m.r$ = 70 to 170
Dr = 1.50 in.
Ds = 1.25 in. minimum, 3 in. max.
V = Unity.

Substituting these values in the formula gives:

$$\text{Twist} = 1.0 \left[\frac{6{,}000}{3.1416 \times 1.5 \times R.p.m.r} - \frac{.318}{1.25 \text{ or } 3.0} \right]$$

$$= \left[\frac{1{,}273}{R.p.m.r} \right] - (.254 \text{ or } .106)$$

R.p.m.r.	$\frac{1273}{\text{R.p.m.r.}}$	$\frac{1273}{\text{R.p.m.r.}} - .254$ Twist Dr = 1.25 in.	$\frac{1273}{\text{R.p.m.r.}} - .106$ Twist Dr = 3.0 in.
70	18.20	17.95	18.09
80	15.90	15.65	15.79
90	14.12	13.87	14.01
100	12.73	12.48	12.62
110	11.57	11.32	11.46
120	10.60	10.35	10.49
130	9.79	9.54	9.68
140	9.09	8.84	8.98
150	8.48	8.23	8.37
160	7.95	7.70	7.84
170	7.49	7.24	7.38

It will be noticed that the difference between the twist is .254 — .106 = .148 turns per inch, which is the difference between the reciprocals of the circumferences of the full and empty bobbins.

To illustrate the use of the twist curves, suppose that we wish to twist 2/24s to ten turns per inch on a frame that corresponds to that for which the curves were drawn. Referring to the chart, the mean between the two curves indicates a front-roll speed of 125 r.p.m. Contraction for such a thread will be around 2%, which when added to 125 gives a front-roll speed of 127.5 r.p.m.

Of the five variables that are used in the formula, the only one that will afford any difficulty in finding will be the spindle speed. Usually spindle speeds are calculated from the drum and whorl diameters, taking it for granted that the calculations give the correct answer. If a stroboscope or a similar instrument is available, it will be found that there is considerable slippage even with good belting conditions. If we consider belt thickness in our calculations, a far more accurate answer will result, because the spindle pulley is a small fraction of the drum diameter, and belt thickness under these conditions becomes an important factor.

$$\text{Spindle r.p.m.} = \frac{\text{(Drum r.p.m.) (Drum dia. + Belt thickness)}}{\text{Spindle pulley dia. + Belt thickness}}$$

It will be noticed that in the calculations for the curves the contraction factor was left at unity. This is the case because the percentage will vary with different threads and is not dependent upon machine condition, as are the other factors. In an article in the Jan. 4 issue of TEXTILE WORLD means were set forth for the calculation of contraction. The writer has found that 2% is a fair average for twisting. Because the contraction is variable, the curves were calculated for V a

unity, so that corrections could be made on the front-roll speed as indicated.

For equipment running a small range of threads, the curves will be reasonably accurate if they are calculated with a contraction factor which is a fair average. In this way no ad-

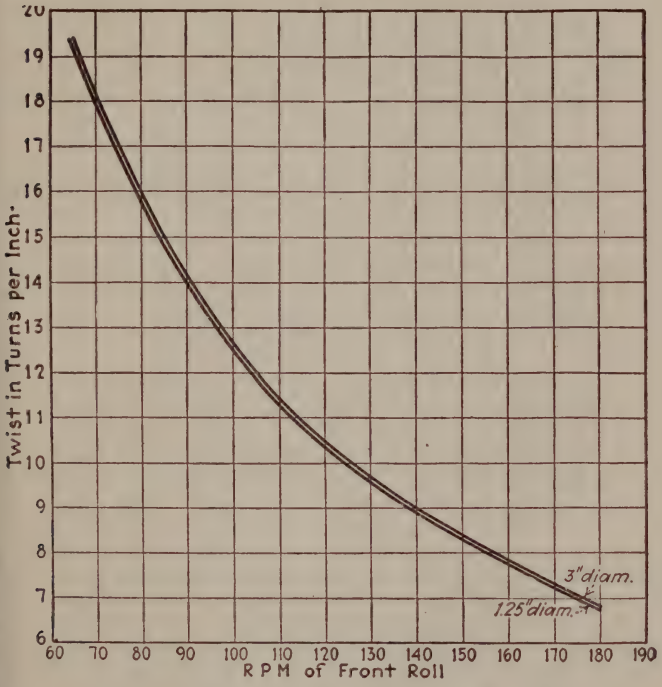


Fig. 1. Twist per inch on a twisting frame

justment will have to be made on the reading of the chart.

It is apparent, from examination of the formula, that the front-roll speed cannot be found directly for a given twist without substituting trial values in the formula, until the desired value is found.

It is possible to rearrange this formula through the use of quadratics expressing front-roll speed in terms of twist. However, the resulting expression cannot be used with accuracy without resorting to long-hand calculations or twelve-place logarithmic tables, so that the practical application of such an expression only complicates matters. For this reason, the twist

formula will be left in its present arrangement. It is the most simple one so far found.

In the average mill using a small range of standard machines, only a few such charts would have to be drawn up to cover the complete range of equipment. This would permit an accurate predetermination of front-roll speeds for a wide range of threads, so that the correct twist gears could be installed from the start of a new run.

The importance of the application of such curves will be clearly demonstrated in the several articles by the same author which will follow this one. It will be shown that from the roving or yarn weight and the front-roll speed, production standards may be determined with a high degree of accuracy. These curves permit the finding of the front-roll speed easily and quickly, and hence they are a very important part of the tools for accurate production planning.

I am indebted to my former employers, MacDonald Brothers, of Boston, for the opportunity of preparing these articles, and to Ward S. Beckwith, under whose direct supervision I worked on the problems, and who gave considerable help in carrying on the investigations.

CALCULATING PRODUCTION STANDARDS AND PIECE RATES FOR WORSTED DRAWING, SPINNING AND TWISTING

By Morris C. Bishop

It has been found that production standards and piece rates for roving, spinning, and twisting (from cheeses) equipment may be calculated by similar mathematical means and formula.

This is the case because the controlling factor is the front-roll speed, with a small part of the time taken up in operations which necessitate the shutting down of the machine. These shut-down periods occur in these machines for similar reasons, such as doffing and replacing the packages in the creels. The general forms of the machines are similar in that the yarn comes from the feeding packages down through the front roll, thence winding onto the receiving packages.

These periods of shut-down for doffing and spool replacements occur at regular and calculable intervals. Their length can be found from time study. Other factors of less regular occurrence are of small importance and may be covered by small percentage allowance.

Delivery Rate in Pounds

As stated, the controlling factor is the front-roll speed, from

which may be calculated the delivery rate in poundage, providing we know the weight of the product expressed in counts or drams. In this and subsequent articles D will designate poundage delivery rate per spindle hour. It will be calculated as follows:

Delivery rate = D = Length of thread × Weight of that length

For drawing operations the weight is expressed in drams per 40 yd., known as "Drams." For this system, D, or the weight in pounds per hour, would be calculated as follows:

$$D = \frac{\text{Dia. front roll} \times 3.1416 \times \text{R.p.m. of Roll} \times \text{Drams} \times 60}{36 \times 40 \times 256}$$

$$= .00051 \times \text{Dia. roll} \times \text{R.p.m. of Roll} \times \text{Drams}$$

This formula, while simple to use, may be represented in chart form by curves. Fig. 2 was drawn up from this formula. For spinning and twisting operations the thread weight is expressed in counts based on a hank of 560 yd.

$$D = \frac{\text{Dia. of roll} \times 3.1416 \times \text{R.p.m. or Roll} \times \text{Counts} \times 60}{36 \times 560}$$

$$= .0093 \times \text{Dia. roll} \times \text{R.p.m. roll} \times \text{Counts}$$

See Figs. 3 and 3a. Fig. 3a represents an equivalent chart to Fig. 3, except that it is in nomographic form and is more simple to read on that account. However, if Fig. 3 is drawn on graph paper divided into millimeters, it is far more accurate than the nomograph for the same size of paper.

Contrary to usual textile practice, counts are to be used in these formulas in their fractional form. Thus 30s substituted appears as the quantity 1/30, while two-ply of that yarn would appear as 2/30. This explains why "counts" appears in the numerator instead of in the denominator.

Since the lineal delivery rate of the front roll exceeds the yardage of yarn wound onto the bobbin by an amount equal to the contraction percentage, neither of these formulas is strictly correct. For work of the highest accuracy, deductions should be made from the poundage equal to the contraction percentage. Even if neglected, this will not cause a serious error with most threads, because contraction is a small quantity and the thread weight itself is subject to considerable error and variation with different moisture contents.

Doffing and Creeling

The doffing periods and feeding-package replacement periods will have to be time-studied and standards set upon them. These will be represented as follows:

Td = Machine stopped period for doffing, in minutes.
Ts = Machine stopped period for spool replacements, in minutes.

Since the weights of stock in delivering and receiving packages control the time between shut-down periods, they are important factors in the calculations, and will be represented thus:

Sw = Net weight of yarn on the spool that is used, in pounds.
Bw = Net weight of yarn wound onto the bobbin, in pounds.
K = Spools per spindle.

J = Doffs per set of spools, or $J = \frac{SW \times K}{Bw}$

Practice in doffing and creeling will vary a great deal according to requirements. Where the feeding packages are replaced after the final doff of a set, often considerable yarn is left on them, in which case the run-out periods must be calculated on the basis of the yarn used, rather than its actual weight. In spinning, the feeding packages are usually replaced singly with the machine running, in which case there is no shut-down period for such an operation.

From the weights of feeding and receiving packages the periods of shut-down time may be calculated by dividing them by the delivery rate of the front roll D.

Running period between doffs = $Rd = \frac{Bw \times 60}{D}$ in minutes.

Running period between spool replacements = $Rs = \frac{Sw \times 60 \times K}{D}$

The time required for cleaning, repairing, etc., necessitating the stopping of the machine, is usually small and can be covered by a percentage allowance, thus:

$$E = 1 - \frac{\text{Percentage lost time for cleaning, repair, etc.}}{100}$$

An additional loss of production lies in individual spindles being out of production. This is usually a small and sometimes a negligible quantity. Its determination will depend upon its cause. Loss in spinning due to lap waste will be equal to the percentage of that waste. Loss in twisting will be very small in most cases. This element will be represented by L, thus:

$$L = 1 - \frac{\text{Percentage loss of production from down ends.}}{100}$$

The number of spindles to be considered in the given condition will be represented by P. This may be for calculation on basis of side, frame, operative, or room.

No allowance for fatigue of the operatives will be made in these calculations. In this case production is based upon the machine and not on the operative. The time standards, however, should contain a factor of allowance.

Standard Production and Piece Rates

Before assembling the twelve variables in a formula, we shall list them as follows:

D = Delivery rate of front roll, in pounds per spindle hour.
Td = Time standard for doffing, in minutes.
Ts = Time standard for replacing a set of spools, in minutes.
Sw = Net spool weight used, in pounds.
Bw = Net bobbin weight, in pounds.

K = Spools per spindle.
J = Doffs per set of spools = $Sw \times K / Bw$.
Rd = Running time between doffs, in minutes.
= $Bw \times 60 / D$.
Rs = Running time between speel run-outs, in minutes.
= $Sw \times K \times 60 / D$.

$$E = 1 - \frac{\text{Percentage lost time for cleaning, repair, etc.}}{100}$$

$$L = 1 - \frac{\text{Percentage lost production from individual spindles}}{100}$$

In setting up the formula, the operation cycle will be considered as the period between run-outs.

$$\text{Machine running time per cycle} = Rs = \frac{Sw \times K \times 60}{D}$$

$$\text{Total cycle length} = \frac{\frac{(60\ Sw \times K)}{D} + Ts + (Td \times J)}{L \times E}$$

$$\text{Machine efficiency} = \frac{\text{Running time}}{\text{Cycle length}}$$

$$= \frac{\frac{(60\ Sw \times K)}{D}\ (L \times E)}{\frac{(60 \times Sw \times K)}{D} + Ts + (Td \times J)}$$

$$\text{Standard production} = \text{Efficiency} \times \text{Spindles} \times \text{Delivery rate.}$$

$$= \frac{60 \times Sw \times K \times L \times E \times P}{\frac{(60\ Sw \times K)}{D} + Ts + \frac{(Td \times Sw \times K)}{Bw}}$$

$$\text{or} = \frac{60\ P\ L\ E\ K\ Sw}{\frac{(60\ Sw\ K)}{D} + \frac{(Td\ Sw\ K)}{Bw} + Ts}$$

The only variable in this formula which varies over a large range is the delivery rate. The others are constants for a given machine. It is therefore possible to set up curves which will represent the complete operating range of that equipment. To illustrate this fact, Fig. 4 was drawn up as a typical representation of curves which would be drawn up for a twisting frame where cheeses are used. The values used and the calculation of the data will be explained as follows:

D = .01 to .12 lb. per spindle hour.
Td = 6 minutes for a doffing period.
Ts = 48 minutes to replace a set of 400 cheeses.
Sw = 1 lb. per cheese.
Bw = .50 lb. per bobbin.
K = 2 cheeses per spindle.
J = 1 × 2 / .50 = 4 doffs per set of cheeses.
P = 200 spindles per frame.
= 400 spindles per operative.
E = 1 — 1/50 = .98, allowing 1 hour in a 50-hour week.
L = 1 — ¼/50 = .995, allowing ¼ of 1% loss.

The formula is:

$$\text{Standard production} = \frac{60\ P\ L\ E\ K\ Sw}{\frac{(60\ Sw\ K)}{D} + \frac{(Td\ Sw\ K)}{Bw} + Ts}$$

Substituting the above values in the formula gives:

$$\text{Std. prod.} = \frac{60 \times 1 \times 2 \times 200 \times .98 \times .995}{\frac{(60 \times 1 \times 2)}{D} + \frac{(6 \times 1 \times 2)}{.50}} + 48$$

$$= \frac{23.400}{\frac{120}{D} + 72}$$

Since the piece rates are to be calculated for 400 spindles, while production standards are on the basis of 200 spindles, the formula for expressing one in terms of the other is as follows:

$$\text{Piece rate} = \frac{100 \times \text{Std. hourly earnings}}{\text{Standard production}} \times \frac{200}{400}$$

A fair average for twisters is $0.40 per hour; therefore,

Piece rate per 100 lb. = 20 / Standard production.

Application of Curves

To illustrate the practical application of these curves, let us take a thread, say 32s, to which we wish to give a twist of 12 turns per inch, on a frame similar to that for which Fig. 1 was drawn (TEXTILE WORLD, May 24, p. 32).

Referring to this figure and reading the mean between the two curves indicates that 104 r.p.m. will give the desired twist with no contraction. Adding 2% to this for contraction gives 106 revolutions per minute, for the front roll.

From Fig. 3 or 3a the delivery rate may be found thus: 2/32 running through 1-in. front rolls at 106 r.p.m. will give a delivery rate of .063 lb. per spindle hour. Multiplying this by 1.5 and subtracting 2% for contraction will be the same as using 104 r.p.m. for finding the delivery rate and multiplying that by the roll diameter.

With a front-roll speed at 104 r.p.m. and 2/32, the delivery rate is read as .062 from the charts. Multiplying this by 1.5 gives .093 as the correct delivery rate.

Referring to Fig. 4 for production standards and piece rates, the following results are secured:

Standard production = 17.10 lb. per frame per hour.
Piece rate = $1.17 per 100 lb. per operative.

The planning department in making out the shop order for this run will be able to specify the front-roll speed, the production rate expected, the piece rate authorized to pay, and the time required to complete the run. This latter point may be simply calculated, knowing the poundage of the lot and dividing by the standard hourly production.

Similar charts may be set up for drawing and spinning frames to cover the complete equipment of the mill. These will enable the planning department to schedule all work with accuracy, and thus will make it possible to predetermine direct labor costs with ease and correctness.

SCOURING LIME-PULLED WOOL

echnical Editor:

What is the most satisfactory material to use in scouring me-pulled New Zealand slipe wool? We have been using ive fig soap and potach, but this method is anything but satfactory as the liquor goes "dead"—the wool coming from the :ouring machine "gummy." (6716)

The lime contained in the lime-pulled slipe reacts with the)ap and precipitates an insoluble lime soap. This accounts for ıe liquor going "dead" and for the "gummy" wool from the :ouring machine. The first liquor or bath should contain)thing but warm water, with the possible addition of some)da ash. The second bowl should contain a fairly strong)lution of soda ash in warm water. The third bowl may)ntain soap as well as soda ash; while the fourth bowl should : a running rinse.

If there is only a three-bowl machine available, then the first)wl will have to contain soda ash; while if a five-bowl maıine is available, the first bowl had better contain nothing ıt warm water. The whole point of the process is to elimiıte or neutralize the lime before allowing the wool to come in)ntact with soap. The soap used is all right, but it must not : used until the wool has come in contact with water and soda ;h.

CALCULATING WINDER PRODUCTION STANDARDS, PIECE RATES AND SPINDLES PER OPERATIVE

By Morris C. Bishop

The usual practice on Foster winders for worsted yarn is t assign a certain fraction of the spindles on a side to an operati and expect her to keep these spindles in operation, repairi breakage, replacing run-out bobbins, replacing cheeses, filli the bins, and keeping the machine in condition. These oper tions are usually done without any sequence or standardizatio The watching for down spindles and walking to these spindl often takes as much as 25% of the total time and causes co siderable nervous and visual fatigue. A great deal of time wasted waiting for work and getting to the down spindle. Su a condition is unnecessary and can be corrected by a change methods.

A winding machine costs only a few thousand dollars, tak up little floor space, uses little power, and requires only a sm amount of maintenance. The life of the machine is also lon so that there is very little burden to winding. Because of th it is very important to gain the greatest possible productio from the labor applied rather than from the machine. In o year several times the purchase price may be spent in dire labor applied to the machine. A winder is in a class by its among textile machines in this respect.

Two Steps Toward Improvement

The first step in improving the methods is to make sure th the machine is running at its highest practical speed. Ribb wood cones will usually keep the cheeses from running over t ends with the increased tension of the thread. In the mill which these studies were conducted most of the machines we speeded up over 50%, increasing the production per machi to nearly an equal percentage and increasing the poundage the cheeses over 10%.

The second step is to make sure that each winder has mo spindles assigned to her than she can keep in operation, to ma sure that she will always have work.

To start the winders on the improved methods, run the m chines until all spindles are run out. Then instruct them start at one end of their section and proceed from spindle spindle in sequence until they get to the end of their sectio Then they are to return to the starting point and start t spindles in sequence again. The number of spindles assign

ill have to be sufficient so that when they return to the start-
g point down spindles will be waiting for their attention.
After the operatives work for a few hours under these
ethods they will probably complain of fatigue. Regular rest
riods sitting down will partially take care of this difficulty.
owever, the proper solution of the fatigue problem should lie
its reduction through other means. Most of this fatigue
ll be caused by the fact that it is usually necessary for the
erator to bend over in picking up the bobbins. This can be
rrected by raising the bins and pushing them forward to clear
e knees, so that arm motions only are required in picking up
e bobbins and the legs are clear when leaning forward to reach
e cheeses. Simplification of the guides may eliminate finger
d arm motions and aid in the reduction of fatigue. The
ıture of the different operatives will have to be taken into
nsideration.
Other incidental improvements will be in the substitution of
ual cheese gages for manual gages, since the cheeses are
ually measured by their diameters. Also, the guides should be
efully inspected for rough edges that would cause excessive
eakage. This latter point is important, because the repairing
a break takes as much time and effort as starting a full
bbin and the net production of such effort averages only half
the yarn on the bobbin. All bobbins and cheeses should be
ought to and taken from the machine by helpers. The opera-
es should keep their own machines clean because they are
ally interested in their condition.
Only the general principles of standardization have been
ated. Conditions will vary so much that each installation of
:h methods will require individual treatment and solution.
complete understanding of these methods cannot be acquired
:hout time study and mathematical solutions of spindles per
erative, production standards, and piece rates. These will
treated in some detail. The investigations on which our
culations are based were conducted on Foster machines,
dels 12 and 101.

Study of Production

Neglecting breakage, production will be the product of ends
rted times the average bobbin weight. The thread size or
ight affects only the number of spindles assigned to each
rative.
The factors affecting standards of production will be listed
follows:

Tb = Standard time to tie in run-out bobbin.
Tc = Standard time to replace a full cheese.
Tk = Standard time to tie in a break.
Tr = Standard time allowance per tie-in for walking back to starting point.
w = Average weight of yarn on a bobbin in pounds.

Cw = Average weight of yarn on a cheese.

H = Bobbins per cheese, or $H = \frac{Cw}{Bw}$

$F = 1 - \frac{\text{(Fatigue allowance in per cent)}}{100}$

$L = 1 - \frac{\text{(Lost time for cleaning, rest, machine, repair, etc.)}}{100}$

$P = 1 - \frac{\text{(Percentage of breakage)}}{100}$

Q = Total time given to each bobbin to accomplish its run-out.

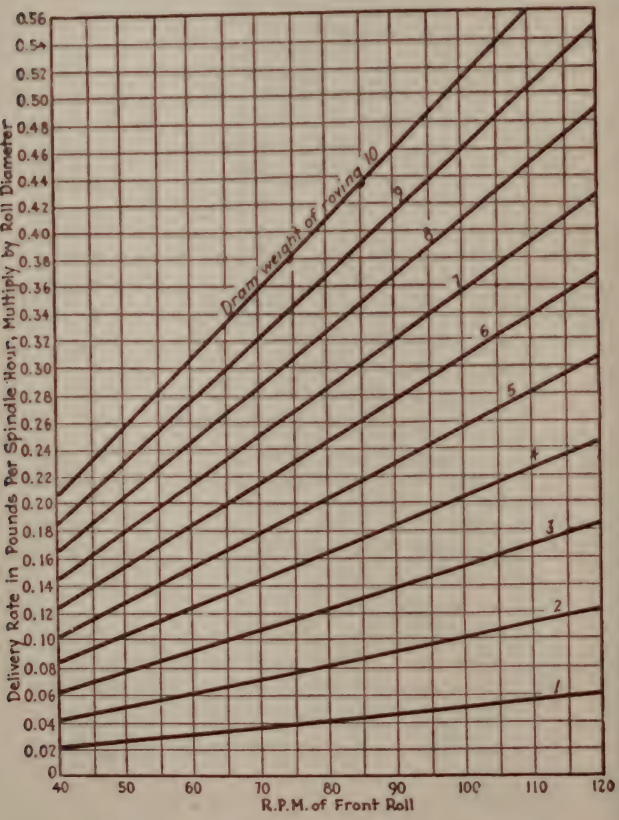


Fig. 2. Delivery rate of 1-in.-diameter front roll in worsted drawing

The total time given to each bobbin to accomplish its run-out consists of the tying-in time Tb plus the breakage repair time, or $Tk \times P$, plus the time for walking back to starting point, or Tr, plus time required to replace a full cheese divided by the bobbins per cheese or Tr/H.

$$\text{Thus } Q = Tb + Tk \times P + Tr + \frac{Tc}{H} \text{ minutes.}$$

Therefore in an hour of continuous operation $60 \div Q$ would

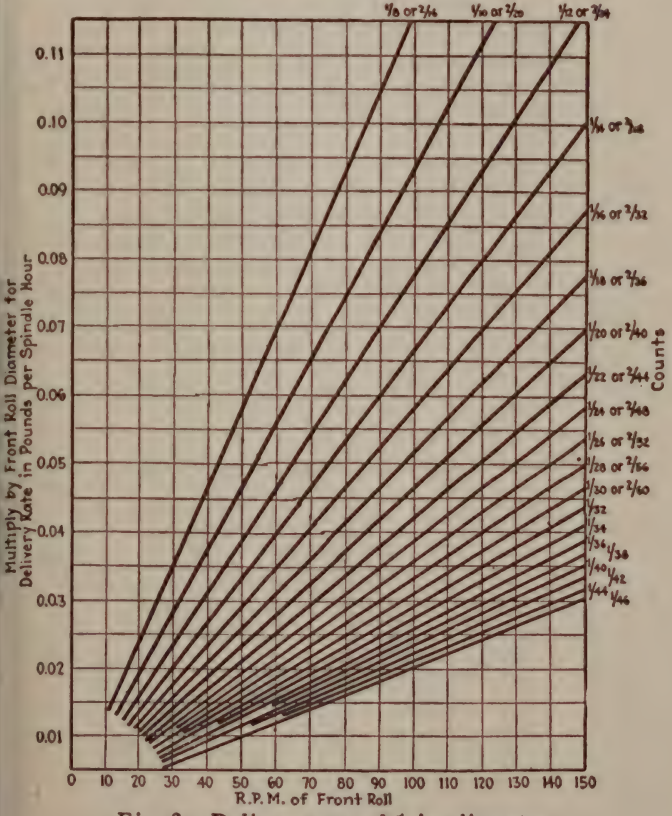


Fig. 3. Delivery rate of 1-in.-diameter front roll in spinning and twisting

equal the total bobbins wound. Multiplying this by the bobbin weight gives the poundage per hour. Multiplying by the two

allowance factors F and L gives the standard production.

$$\text{Standard production in pounds per hour} = \frac{60 \times Bw \times F \times L}{Tb + Tk \times P + Tr + \frac{Te \times Bw}{Cw}}$$

The formula for piece rates would be:

$$\text{Piece rate in dollars per 100 lb.} = \frac{1.67 \times Q \times \text{Std. hrly. earnings}}{Bw \times F \times L}$$

No reference has been made to the counts of the yarn o machine speeds. This is because they do not affect productio

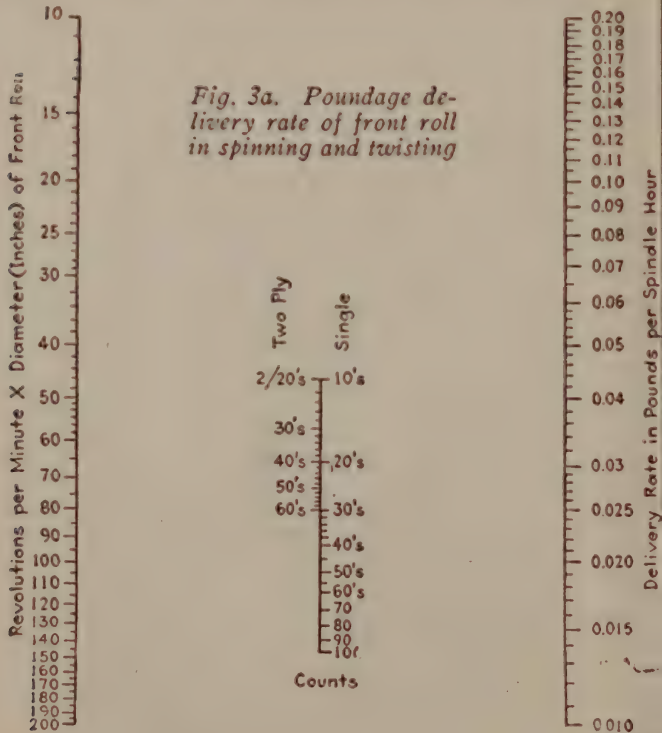


Fig. 3a. Poundage delivery rate of front roll in spinning and twisting

rates directly. However, they do determine the number o spindles that should be assigned to each operative. This will b calculated as follows:

:t
A = Spindles per operative.
R = Running time in minutes of the yarn on average bobbin.
D = Delivery rate of the roll in pounds per spindle hour.

$$D = \frac{3.1416 \times \text{Dia. of roll} \times \text{R.p.m. of roll} \times 60 \times \text{Counts}}{36 \times 560}$$

$D = .00935 \times$ Dia. of roll $\times$ R.p.m. of roll $\times$ Counts.
Counts are always expressed in my formulas in their fractional form; i.e., 1/30, 2/30, etc.

$$\text{Then } R = \frac{60 \times Bw}{D} \text{ minutes.}$$

For the most economic operating conditions the spindles signed to each operative should just exceed her capacity to in ends. The proper number to assign to each operative will ry according to individual skill but may be calculated for the andard operator by using standard time values, thus:

$$A = \text{Standard spindles} = \frac{R}{Tb + Tr} = \frac{60\,Bw}{D\ (Tb + Tr)}$$

Variations from the standard number as calculated in the ove formula will permit a number of combinations of spindles signed to each operative which will be an aid in dividing a ame side. If the winding frames are arranged end to end, the fficulty of settling on the proper combinations will be partially moved, since the sections will be divided between two frames.

Typical Solution

Typical solution of known winding condition follows:

$Tb = .12$ min.
$Tc = .20$ min.
$Tk = .12$ min.
$Tr = .01$ min.
$Bw = .08$ to $.14$ lb.
$Cw = 1.5$ lb.

$$F = 1 - \frac{10}{100} = .90.$$

Items included in L are:

1 hour allowance for rest periods.
½ hour allowance for cleaning down time.
½ hour allowance for machine repair.
Totaling two hours out of 50-hour week.

$$L = 1 - \frac{2}{50} = .96$$

Roll diameter = 2.50 in.
R.p.m. of roll = 2,200.
Count = 1/28s.

$P = 0$ to $.25$.

$$D = .00935 \times 2.50 \times 2{,}200 \times \frac{1}{28} = 1.837 \text{ lb. per spindle hour.}$$

$$R = \frac{60 \times Bw}{D} = \frac{60 \times (.08 \text{ to } .14)}{L\ .837} = 2.61 \text{ to } 4.57 \text{ min.}$$

$$A = \frac{32.65 \times Bw}{.12 + .01} = 251 \times Bw$$

Tabulating the calculations:

TABLE A

Bobbin Weight Pounds	Minimum Standard Spindle
.08	20.1
.09	22.6
.10	25.1
.11	27.6
.12	30.1
.13	32.6
.14	35.1

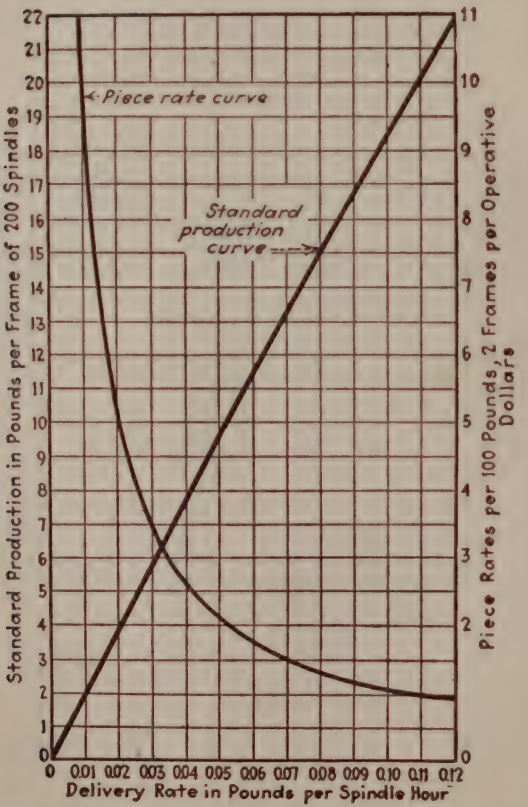

Piece rate curve
Standard production curve
Standard Production in Pounds per Frame of 200 Spindles
Piece Rates per 100 Pounds, 2 Frames per Operative Dollars
Delivery Rate in Pounds per Spindle Hour
0 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

Fig. 4. Production standards and piece rates for twisting from cheeses

With this table as a guide the proper number of spindles per operative may be determined, knowing the average bobbin weight.

The piece rates per 100 lb. are calculated as follows:

$$\text{Piece rate} = \frac{1.67 \times Q \times \text{Std. hrly. earnings}}{Bw \times F + L}$$

$$= \frac{1.67 = .45\ (.12 + .01 + .12\ P + .20\ Bw\ /\ 1.5)}{Bw \times .90 \times .96}$$

$$= \frac{.869\ (.13 + .12\ P + .0133\ Bw)}{Bw}$$

$$= \frac{.113 + .1042\ P + .0116\ Bw}{Bw}$$

Tabulating the calculations:

P	$.1042P$	$.1042P+.113$	Bw	$.0116\,Bw$
0	0	.1130	.08	.00928
.05	.00521	.1182	.09	.01043
.10	.01042	.1234	.10	.00160
.15	.01563	.1286	.11	.01276
.20	.02084	.1338	.12	.01391
.25	.02605	.1390	.13	.01510
			.14	.01624

With these figures the values of $0.133 + 0.1042P + 0.0116\ Bw$ may be set up for different breakages and bobbin weights, thus:

Values of Bobbin Weight (Bw)

P	.08	.09	.10	.11	.12	.13	.14
0	.12228	.12343	.12460	.12576	.12691	.12810	.12924
.05	.12748	.12863	.12980	.13096	.13211	.13330	.13444
.10	.13270	.13385	.13502	.13619	.13733	.13582	.13966
.15	.13791	.13906	.14023	.14139	.14254	.14373	.14487
.20	.14312	.14427	.14444	.14660	.14775	.14894	.15008
.25	.14833	.14948	.15065	.15181	.15296	.15415	.15529

Dividing each of the values in the preceding table by the bobbin weight gives the piece rate:

Bobbin Weight

P	.08	.09	.10	.11	.12	.13	.14
0	1.530	1.370	1.246	1.144	1.057	.985	.923
.05	1.593	1.430	1.298	1.191	1.102	1.023	.960
.10	1.660	1.486	1.350	1.240	1.146	1.063	.996
.15	1.727	1.545	1.402	1.287	1.188	1.103	1.032
.20	1.790	1.602	1.454	1.336	1.230	1.143	1.070
.25	1.853	1.660	1.5065	1.380	1.273	1.185	1.108

The piece rates are shown in curve form from these figures in Fig. 6.

Standards of production per operator hour may be calculated as follows:

$$\text{Std. Prod.} = \frac{.45}{\text{Piece Rate}}$$

	Bobbin Weight						
P	.8	.09	.10	.11	.12	.13	.14
0	29.4	32.8	36.2	39.4	42.7	45.7	48.7
.05	28.2	31.5	34.7	37.8	40.9	43.7	46.9
.10	27.1	30.3	33.4	36.3	39.3	40.8	45.2
.15	26.1	29.1	32.1	35.0	37.9	40.4	43.6
.20	25.1	28.1	31.0	33.7	36.6	39.4	42.0
.25	24.3	27.1	29.9	32.6	35.3	38.0	40.7

These values are shown in curves in Fig. 5.

A study of the two sets of curves showing production standards and piece rates will clearly reveal the loss of breakage and the cost of unfilled bobbins. Under the irregular methods of winding, these points were recognized to be a cost factor, but in these methods the losses themselves may be accurately evaluated.

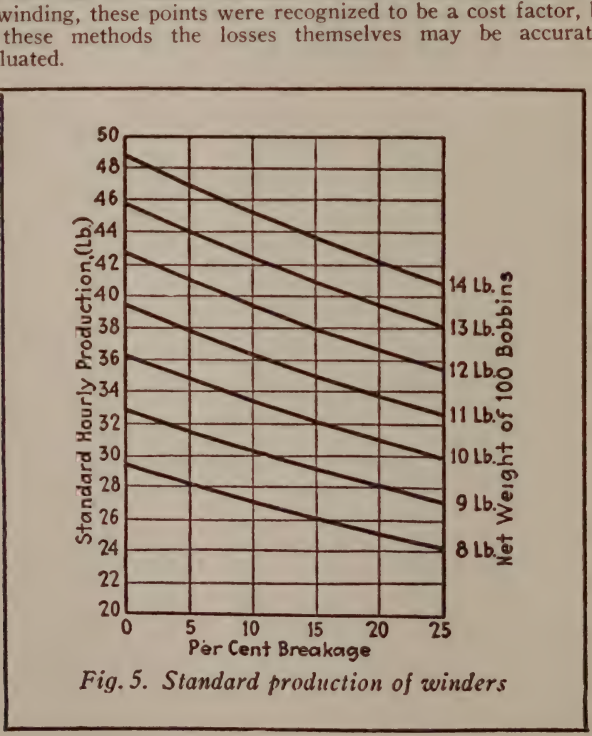


Fig. 5. Standard production of winders

The factor of full bobbins cannot be emphasized too strongly. Often the savings in winding cost alone will pay for the investment for larger spinning caps in two years, if small caps are being used and the thread can be spun on large caps. The same principle applies to winding from twister bobbins.

Cheese weight is a factor, but obviously only a small one in affecting production rates.

The values given in the two sets of curves are typical for winding from worsted and mohair spinning bobbins. The time study values are accurate and reasonable. The standards of production have been borne out in practice as attainable, representing a large increase in production over previous methods.

The principles of basing production on knots tied and arrang-

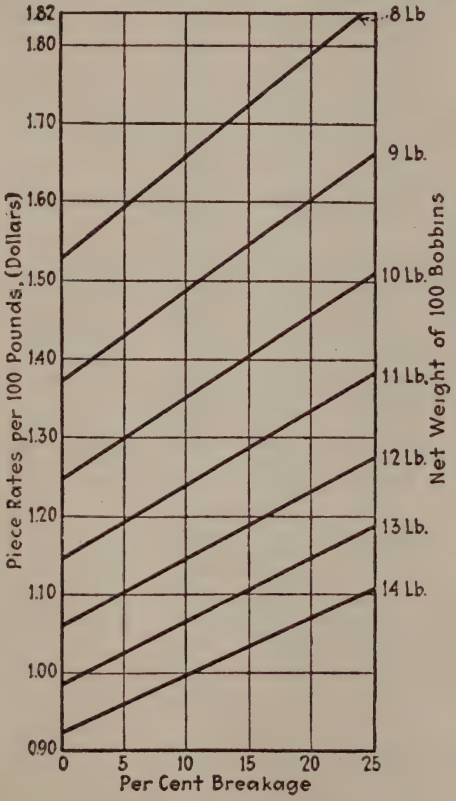


Fig. 6. Piece rates for winding

ng operations in regular sequence are not confined to worsted ınd mohair threads alone. These principles may be applied to ɔther threads and equipment.

To illustrate the practical application of the charts, let us take a typical condition and apply the charts to it. Take winding single 28s from spinning bobbins weighing 11 lb. per 100. If the roll diameter is 2.50 in. and turns at 2,200 r.p.m., from Table A, the standard number of spindles per operative is 27.6. If the frames have 50 spindles per side, two operatives who are slightly below standard capacity would be kept busy on a frame side.

At the start of the run the foreman of the winding room would count the breakage. Let us say that it averaged around 10%. Referring to Fig. 5, standard production on this yarn will be 36.4 lb. per operative hour. From Fig. 6 the piece rate and standard cost is $1.24 per 100 lb.

If that lot comprises 1,000 lb. the standard time to complete the run will be

$$\frac{36.4 \times 2}{1{,}000} = 13.7 \text{ hr. for a frame side of } 2 \times 27.6 = 54.2 \text{ sp.}$$

However, the frame side has only 50 spindles, so that the corrected time will be

$$\frac{13.7 \times 54.2}{50} = 14.8 \text{ hours for a frame side of 50 spindles.}$$

It is apparent that the only conditions which the planning department cannot control are the bobbin weight and breakage. However, past performance on similar yarns will be sufficient indexes as to how the thread will be expected to run. Any discrepancy of large proportions in such work should be investigated.

CONDITIONING WORSTED YARN

Reasons Why It Is Necessary and Methods Employed

By E.N.S.

There is a diversity of opinion regarding the methods of conditioning yarn in the worsted trade. This is to some extent due to individual ideas and the absence of principle, but chiefly because wool is a commodity which readily absorbs moisture either directly applied to it by mechanical means or by natural absorption from the atmosphere. The latter method, however, takes up a large amount of time and floor space.

Spinners of wool yarns usually condition their yarn to a far greater extent than spinners of lusters, mohairs, and alpacas, as these last-named yarns very quickly show the presence of excessive moisture in the curly and cockled appearance of the filling and cloth produced from it. In crossbred and botany yarns the presence of moisture is not so apparent, and is often not detected until woven into cloth. The evaporation of the moisture causes the cloth to shrink unevenly, and the bad effect is intensified when the filling from one bobbin lies even and level while the next is cockled and shrunk.

Influential Factors

This curling and cockling may all be avoided if the yarn is spun correctly under suitable conditions; but when it is sometimes nearly impossible to make certain classes of fibers curl when spun into yarns, it is impossible to get others level and straight. The factors which influence the appearance of the yarn are the draft, the twist of the roving, and the setting of the ratch and carriers in spinning. Generally speaking, to produce a straight and level yarn it is necessary to have a roving made to a weight that will give a draft in the spinning at least equal to the number of inches in length of the longest fibers—but varying according to the class of material and the condition of the roving. The twist of the roving should be on the soft side and the ratch and carriers should be open, with the back rollers one inch farther away from the front rollers than the length of the material.

Yarns spun from a hard-twisted roving with a short draft and close setting in the rollers and carriers curl to a great extent. Anyone of these three factors separately, however, will often cause yarn to curl. Very often the atmospheric conditions under which the yarn is spun make all the difference between producing straight and curly yarn. This is often noticed on Monday mornings, particularly after a damp week-end, and carriers have often to be moved back, or one row removed, to take the curl out of the yarn which on Saturday morning was perfectly level. Presumably, this is caused by the top layer on the rovings absorbing the moisture from the air, making the top layers set harder, and so taking more to draft them out. This has to be counteracted by easing the ratch or carriers.

Adding Moisture

Yarns spun in dry rooms are from 4 to 7% light, or below the standard amount of moisture allowed, and it is necessary to add moisture up to the percentage allowed. Some question the wisdom of conditioning yarns by adding moisture to them, but there is no doubt that yarn sets quicker when conditioned than when dry. The added moisture gives to the yarn elasticity and flexibility, and makes it better able to withstand sudden strains or tension. It kills any tendency to curliness or liveliness caused by excessive twist, and gives a fuller appearance.

There are many ways of adding the moisture required in yarns. These are of varying merit. A machine made for this purpose is self-contained, requires very little room, power and attention. On the machine are two very fine rose nozzles which turn the water into a very fine spray, and this is forced on to the yarn as it is passing underneath on an endless lattice. As the rollers of which the lattice is composed, pass under-

neath these sprays, they receive a rotary motion, which ensures that all the yarn receives the same treatment.

Any pressure can be obtained up to 100 lb. and any amount of moisture can be added either by altering the speed of the lattice (faster for a less amount) or closing one of the nozzles. A trough underneath the lattice catches the surplus water, which then runs back to the tank. This machine is continuous in its action, and 80 lb. of yarn can be conditioned in a few minutes on it. The conditioned yarn from the front of the machine is dropped into a basket placed to receive it, and should then stand at least one day to allow the moisture to distribute itself evenly throughout the yarn.

Another system, and one which is often preferred to the former, is to spread the full bobbins of yarn on wet sheets and then cover with another sheet, thus building up rows of bobbins in suitable trays. To prevent the yarn from becoming too wet in places, sheets of paper, thick and dry, are often placed between the bobbins and the wet sheets. This is also a favorite way of conditioning reeled hanks of yarn. When treating spools or bobbins, time and labor are required for spreading them; but, given reliable help, the yarn is more evenly conditioned in this manner than by the machine.

A new process, introduced from the Continent, is based upon an automatic measuring of the amount of water to be sprayed on to a weighed quantity of yarn. This guarantees yarn in uniform condition. The water is applied in finely divided particles and is well distributed.

OVERCOMING UNEVEN AND TWITTY ROVINGS IN BRADFORD DRAWING

By Canadian

Many managers and overseers have trouble in producing a level roving from the tops supplied to them. Several factors may be taken into consideration as to causes, two of the chief being (1) the amount of skin wool blended into the tops and (2) the blending of several qualities of tops to get down to a price proposition.

These notes are intended to show the way to overcome the uneven and twitty rovings that are very much in evidence, causing untold trouble in the spinning, weaving, and knitting departments. The method advocated has been tried out and used successfully by the writer over a considerable period of years, and will fully repay any manager or overseer who will put it into practice. Some variation will have to be made to suit individual sets, and this can be left to the discretion of the overseer responsible.

For example, we shall take as a representative set-up a drawing (using from 60s to 70s Botany tops) containing the following machines and layout:

Machine	Ends up	Drafts	Inches Ratch	F.R.	B.R.	Pitch	Bobbins
Can Gill	6	5	Open	2	2¼	...	....
Spindle Gill	5	5	Open	2	2¼	12¼	14x9
Drawing Box	4	5	6	4	2¼	12¼	14x9
Weight Box	4	5	6	4	2¼	11½	14x8
Drawing Box	3	5	6	4	2¼	10½	12x6
1st Finisher	3	6	6	4	2	9½	10x6
2nd Finisher	2	6	6	4	2	7¾	9x5
Reducer	2	6	6	4	2	6	8x4
Rover	2	7	5¼	4	2	5½	6x3

In the can gill box and spindle gill box, care must be taken to see that the sliver is thoroughly held by the faller pins. The sliver must not be forced to the bottom of the pins and care must be taken to prevent any riding on the top of the pins.

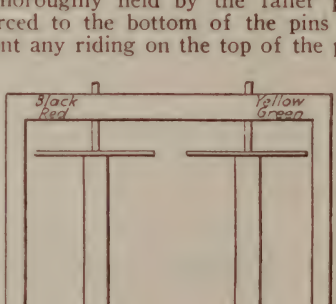


Fig. 1 (Left) Side of sliver can with large cross Fig. 2 (Above) Placing of cans behind spindle gill, seen from top. Fig. 3 (Right) mark of top rail

The knock-off motions must be in working order on al machines, and care must be taken to set them properly—espe cially on the can gill box, as this is one of the most importan links in the system.

In the case of a double-head can gill box, the cans mus be of uniform weight and marked with a large black cros painted on one side, as in Fig. 1.

Each can on being filled must be carefully weighed, and th weight plainly marked on the can. Five cans should be bal anced properly and placed at the back of the spindle gill bo in the manner indicated in Fig. 2. The object of the markin on the cans will now be apparent, viz.: to prevent all th slivers from one side of the can gill box being fed up one sid of the two-spindle gill box.

Coming now to the front of the spindle gill box, we hav the bobbins painted in four colors; for example, black, red yellow, and green. They are doffed from the spindle gill bo in the following order: first doff, black and yellow; second doff, red and green; third doff, black and yellow; fourth doff red and green; and continuing in the same order.

It is essential that the operative be instructed to place th same colors on the same spindle each doff; and, in order t insure this, it is suggested that the top rail of the box b plainly marked, as in Fig. 3.

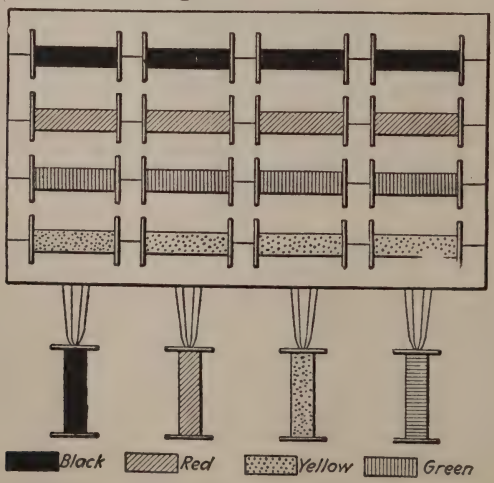


Fig. 4. Correct Creeling for the Drawing Box

From the spindle gill box, four bobbins are taken and placed in the creel of the drawing box in the order given in Fig. 4. The object is to distribute the slivers, and to be sure that four ends do not go up the back rollers of the drawing box from the same spindle of the gill box.

The same practice is to be followed for the weigh box, and the overseer will be agreeably surprised to find practically no variation in his weights from the weigh box.

Coming from the weigh box to the second drawing box, the ends up will be three. The color of bobbins to put up is left to the discretion of the overseer, but care should be taken to use bobbins from different spindles as far as may be possible.

The whole idea may be carried through to the rover, and will, if followed out faithfully, eliminate considerable of the uneven yarn so prevalent today.

LOOSE LEATHER COVERS ON TOP FRONT ROLLS IN WORSTED DRAWING AND SPINNING

Technical Editor:

Will you kindly give us any information that will enable us to overcome the difficulty of having the leather covering on the top front rolls of our worsted drawing and spinning frames repeatedly loosening and coming off. We have used animal glue, and then a mixture of animal glue and rosin in different proportions, but to no purpose. We might say of course that we have no trouble where the boss of the roller is made of wood. The iron bosses have been boiled in a solution of trisodium phosphate before covering to insure their being absolutely clean. (6757)

Your experience is similar to that of many mills that have been willing to try all kinds of mixtures, hoping eventually to obtain a satisfactory adhesive. Why experiment when you can purchase a guaranteed roll-covering cement that is very efficient for wood or iron bosses. We cannot give you any formula as we do not know of one that we can guarantee. However, we are sending the name of a manufacturer of a high-grade roller-covering cement or glue that will give good results.

CEMENT FOR COVERING IRON ROLLS

Technical Editor:

I note the inquiry in the March 16, 1929, issue regarding a cement for sticking leather covers to iron rolls for worsted drawing and spinning. The following formula makes a cement that is used at one of the largest mills:

8 lbs. glue
2 lbs. gelatine
15 ozs. Burgundy pitch
4 ozs. acetic acid in 4 ozs. water
2 ozs. nitric acid in 2 ozs. water
5 qts. water

The rolls should be cleaned in muriatic acid twice, washed in caustic soda, and then rinsed in hot water. We find that this cleaning process is very important, as no cement will stick if the rolls are not properly cleaned. For the glue we use the best grade of Coignet glue obtainable. The gelatine serves to make it set. C.J.R.

TENSIONING WORSTED YARNS WHEN REELING FOR COUNT

Technical Editor:

In determining the count of worsted yarn, is there any standard method of putting tension on the thread when reeling? Most superintendents hold it in their fingers. Of course if they increase the tension the count will be lighter, and vice versa. A prominent spinning company is said to wrap the thread twice around the pigtail so that it is not held in the fingers. When we have tested single yarn in that manner it sometimes breaks. Sometimes the count determined by wrapping the yarn twice around the pigtail differs from the count in the same yarn as found by our superintendent in his own method. Naturally we have to accept his method of tensioning as the best because our customers do not complain about the count. Will you kindly give us your views on this subject? (6783)

We do not know of any device, attached to a yarn reel, which automatically indicates the tension in the yarn between the yarn guide and the reel. There are supplementary tension devices suitable for handling hard-twisted or very elastic and kinky yarns. Most reels are equipped with a series, in duplicate, of vertical and inclined spindles, four to seven in number, so that the yarn may be withdrawn over the top or from the side of the package as circumstance demands. Holding the yarn by the hand to tension it while reeling is a very old and efficient method. The hand is very sensitive, indicating quickly a change in tension so that one soon becomes accustomed to the right "feel."

We follow the custom of wrapping the yarn twice around the pigtail for single and ply yarns when pulling yarn over the end of the package. When pulling yarn from the side of the package we give a single wrap around the pigtail or pass the yarn direct to the reel, according to the conditions noted at the time of reeling. Just as reeling commences we observe the tension on ends to be sure that conditions are satisfactory

before going ahead. Many times we find it necessary to use the hand to give additional tension.

In addition to the use of the hand, or the wrapping of yarn around the pigtail, the speed of the reel plays an important part in affecting the tension on the end during reeling. Most differences arising when two or more persons test the same yarn for counts, using the same reel, are due to variations in the r.p.m. of the reel. We have found 40 to 45 r.p.m. of the handle, giving 80 to 90 r.p.m. of a one-yard reel satisfactory. The speed should be uniform throughout reeling. When this speed is exceeded we have trouble, the counts appearing to be light, and many ends will break when reeling soft-twisted single yarns.

The facts you state are all in favor of your superintendent. Duplicate his method. A superintendent who can make worsted yarn so that the "customers do not complain" in these trying times must know his business. Your method of tensioning or the speed of the reel when wrapping (perhaps both) may be wrong, which you can easily determine.

In TEXTILE WORLD of Mar. 13, 1926, page 43, you will find an illustration (reprinted herewith) of a machine for testing length of skein after wrapping; also supplementary information relative to the procedure when testing for count of yarn. With this length tester you can take skeins reeled by various persons and determine variations in length. If your skeins are shorter than the superintendent's, then your tension or speed of reel is excessive.

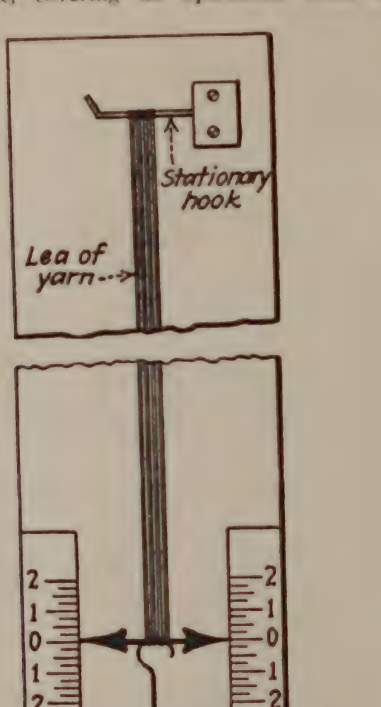
WARP PREPARATION WITH RIGHT- AND LEFT-TWIST YARNS

Technical Editor:

I was very much interested in the article in the March 9 issue of TEXTILE WORLD about handling a worsted warp of right and left twist. During the last two years I have had to handle fine cotton warps (2/120) of right and left twist, and I have always had a terrible time. On some of them I have failed to get them running. They have been rolled together so badly that it has taken two days to get them separated. I have tried right twist on one warp and left on another, but with very little success. I realize that keeping the yarn under tension at all times will help, but how a drawing-in girl can do this and draw the ends through the drop wires, harness, and reed, and then the loomfixer take the warp and put it in the loom and during these operations keep the warp from rolling, I am unable to fathom.

I am sure there are some men in the textile industry that can start these warps with very little trouble. The cloths I

have tried to make are exact duplicates of cloth that was dissected by competent men; therefore it proves that someone can make this kind of cloth. Can you fully explain how these warps are made, covering all operations from warping to



Device for Testing Length of Skein After Wrapping

cloth in the loom, explaining at each operation how to stop th yarn from rolling together, and if it does roll how best t separate it. (6790)

A manufacturer running these warps replies as follows: W have no difficulty with right- and left-twist yarns, but th warps require careful handling. To start with, all our cotto

yarn is properly conditioned on the spinning bobbins before warping. Right and left twists are put on separate section beams. In running through the slasher we stain the left twist blue.

When drawing-in, put the warp in the frame. The yarn must be tight with the exception of about six inches. After drawing in drop wires, keep the warp very tight. Work the drop wires back, then draw in the harnesses. Also keep the yarn tight after drawing through the harnesses. Work the harness back a short way to leave enough yarn to draw through the reed. After reeding is completed, tie knots very tight to the reed. Put the warp on the truck and the harnesses on the hooks of the truck. Run to the loom. Advise the loomfixer that this warp must be kept tight while he puts the harnesses in the loom. Then take the reed and put in the lay. Put the lay caps on and bring the lay to front center. Put the warp in the loom, keeping the yarn tight. After this is done, turn the loom to the bottom center. Untie the knots at the reed and the fixer will have enough yarn to tie to the apron. After this is done, wind the warp down about four inches, then put in picks by hand until everything is tight and straight. Proceed with the weaving for a few inches and then put in two lease rods between the harness and the drop wires. This is the way we start up right- and left-twist yarns, and we have no trouble.

SHRINKING PROCESS LESSENS LUSTER

Technical Editor:

We make a very fine men's wear fabric from fine half-blood and Australian tops. The cloth is put through a cold-water shrinkage process and then re-pressed and delivered to the trade ready for the needle. The goods, however, seem to lose quality and luster more than they should. Can you suggest a reason? (6853)

The change in the appearance is due to fiber disturbance. Many mills have overcome similar trouble by installing the mantle machine of Curtis & Marble Machine Co. for treating the goods. Curtis & Marble Machine Co. will no doubt gladly arrange for the treatment of a sample piece of your fabric.

A practical worsted finisher replies to the question as follows: If the goods are satisfactory in quality, handle, and luster when originally finished, before going through the cold-water shrinkage process, the cause of the loss in quality and luster is of course the shrinkage. A piece of worsted goods which has been stretched on a dryer, sheared, and pressed, naturally presents a smoother surface to the pressing machine and takes on a better press luster, with the appearance of superior quality and handle.

The wetting-out and shrinking causes a crinkling effect which gets pressed into the goods, leaving the surface irregular in-

stead of flat. This can be felt by the hand, as there are small interstices all over the piece which fail to get the full benefit of the pressing. Hence the loss of luster and the depreciation in quality.

GILLING IS NOT CLEARLY UNDERSTOOD BY MANY WORSTED MEN

The accompanying article is based upon an inquiry concerning slubs which was recently received by our Questions and Answers Department. The reply is much more than the inquiry called for, but it is designed to help, besides the inquirer, many others who are experiencing difficulty in gilling worsted sliver. The process is not as simple as it appears to many, and careful attention must always be given to certain important details.

The following inquiry was recently sent to our Questions and Answers Department:

We have experienced quite a lot of trouble with drawing slubs made from a blend as shown by enclosed sample. These are so numerous that the yarn inspection in the spooling takes three times longer than normal. We think that the trouble is in one of the tops or in a combination of the tops. We surmise this because other blends of tops which we have run through the same set immediately before and after have been free from this trouble. We have also run this blend through other sets and had the same trouble. The drawing is the open system, 9 operations, with no draft exceeding 5½. We put 2½% olive oil on this stock.

The slubs in some instances look like rubber waste, etc., but such is not the case as we have run several small test lots through and taken great care that the fallers, carriers, and rubbers were perfectly clean. A singular thing about it is that in the test lots we have run through we have in turn left out each individual top, and yet the slubs were as numerous as ever, excepting in one case where the top we put in was a much finer and better top than the one we took out. However, in this case the difference in the prices of the tops makes the change prohibitive. This is the only change in this case which gave any better results.

You will notice in the samples that there is a very short dry-combed top. We tried gilling and oiling this one separately before blending, but with no better results. This is the top that we suspect, and on leaving this one out and using the finer top in its place we did get, as I have already stated, better results. However, if we left this top out and used the same percentage of one of the other tops of the original blend,

we again ran into trouble. I would be very much interested to have your comments on this rather perplexing problem.
(6772)

Slubs Composed of Short Fibers

This is an important question. We have examined carefully the slubs in the samples of roving and yarn submitted and agree that they are not caused by rubber waste or waste from any other source. We do call attention to one fact; that is, in almost every case the slubs were composed of very short fibers which were identical in shade with two of the sample top slivers submitted: No. 89 and No. 56. Examination of the slubs suggested two possible causes of the trouble:

(A) Tops containing too much short fiber
(B) Defective gilling
    (1) Overdrafting
    (2) Uncontrolled distance too great

Analysis of the tops submitted proved very interesting. Before stating the results of the analysis we confirm your suspicions that No. 89 and No. 56 are not suitable tops for you to process with your present gill boxes. It is our opinion that No. 56 is a very poor top, even for the French system, and should not be used in any blend of tops to be processed in open drawing.

The top-analysis results are as shown in Table 1.

We would comment on the various tops as follows:

No. 37. Fair top. Staple short for $\frac{3}{8}$s quality.

No. 43. A blended top. Not a straight $\frac{3}{8}$s, some half blood in it. Staple not quite as regular as No. 37 but has better spinning qualities. Few kemps.

No. 36. Very fine top. Excellent spinning qualities.

No. 28. Fair staple. Inferior to No. 36.

No. 56. Inferior staple, excessive shorts, poor color. Evidently a French-combed top containing a high percentage of clothing wool. Only suitable for French system.

No. 89. Poor staple. A little better than No. 56. Quality not quite as fine as No. 56. Dangerous to use on ordinary gill boxes unless intelligently blended. Twenty-five per cent of this would be excessive.

Two Unsuitable Tops

This analysis at once revealed two tops which would cause excessive slubs if processed on ordinary gill boxes with open drawing. We were further interested and divided the "draws" of No. 56 and No. 89 into groups of fibers, weighing carefully each group to ascertain the actual percentage by weight of the various lengths grouped together.

TABLE I

Top No.	Maximum Fiber Length Inches	Minimum Fiber Length Inches	Mean Fiber Length Inches	Remarks
37	5	1¼	2¾	Freak fibers, six inches
43	5	¾	2¼	
36	4½	¾	2½	
28	5	¾	2¾	
56	4¾	¾	1⅞	
89	5	¼	2	Few coarse fibers seven inches long

	No. 56	*No. 89*
All fibers up to one inch	25.33%	8.7 %
All fibers one to two inches	32.0 %	28.26%
All fibers two to three inches	34.66%	43.48%
All fibers over three inches	8.01%	19.56%

The above clearly shows that for staple, No. 89 is better than No. 56. It requires an enormous number of short fibers to make or equal 25.33% of a blend. We strongly advise the disposal of No. 56 top to some French spinner. No. 89 could be processed using say 20% to 25% in blend if the gill boxes are adapted to handle this short staple. This explains what caused the slubs as far as the tops are concerned, but by your tests you had discovered this fact already and we presume that you are anxious to learn why such a top will cause slubs.

Explanation of Gilling

Gilling as a process is not very clearly understood by many combing and drawing overseers and we may safely include superintendents of worsted top and yarn mills. Noil is removed on the Noble comb through the medium of pin control. The small circle holds the shorter fibers while the drawing-off rolls drawn out of the pins fibers long enough to reach the nip of rolls. The difference in speed (draft) makes combing possible if the right pinning is used. Pin control and draft are used in gill boxes. It is supposed that the fallers merely perform a straightening action, but they also possess a control over the fibers so that most fibers are held until their tips or ends reach the front roll nip.

A comb circle has a continuous rotary movement; the small circles retain the short fibers which are removed as noil. Fallers have an intermittent contact with the wool. As they reach the nip of the front rolls they hold back the short fibers, endeavoring to retain them. As the faller is dropped on to lower saddle, due to the continuity of the wool in the machine, the short fibers held by faller are retained among the longer fibers. Just as a faller is removed a peculiar condition exists. The control is shifted away from front-roll nip to the next faller which we always call the second faller. Any fibers not long enough to be controlled by the fallers respond to the pull of the fibers

being drafted, and a result of this action a series of short fibers, retained by the faller until it is removed, are suddenly pulled forward to the roll nip.

TABLE II

Operation	Ends	Draft	Weight for 40 Yards	Ratch	Remarks
Can gill	4	4.8	315	Close	No back draft on gills
2 Sp. gill	4	4.8	262	Close	Very little pressure
Drawing	4	5.2	202	Close	on back rolls
W. box	3	5.2	116	5½″	In drawing boxes avoid
Drawing	3	5.1	68.5	5½″	too soft twists
Finisher	3	5	41.1	5½″	
Reducer	2	5	16.4	5½″	
Rover	1	5	3.3	5″	

This is a scientific explanation of the source of faller bars and unevenness in a gilled sliver. Naturally if short fibers become grouped during gilling, especially in open drawing, it is almost impossible to draft (separate) them, and unevenness in the yarn results; or where the shorts are excessive, slubs result. On an ordinary gill box, two-inch diameter front roll, three-eight-inch pitch, No. 8 apron, the approximate distance between the nip of the front roll and the pins of the second faller is 1.4 inches. This means that all fibers 1.4 inches, or less, if straight or parallel with sliver, and many longer fibers which are not parallel to the center of the sliver, cannot be gilled. Successive gillings will accentuate the grouping.

Control Nearer Nip

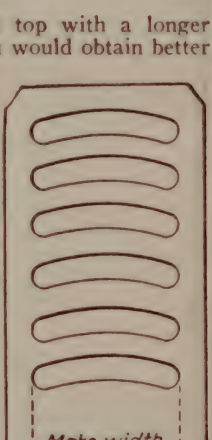
The O.P.S. gill box and intersecting gill boxes are really attempts to control the fibers to a point radically nearer the front roll nip than is possible in the ordinary gill box. These improved gill boxes, through the use of small-diameter front rolls and supplementary faller motions, reduce the uncontrolled distance to .75 inch approximately. If these gill boxes were not used before French combs the noil would be increased. When intersecting gill boxes are used before the Noble comb the noil is reduced 1½ to 3%. At the present time every comber is anxious to use them before the comb, but most drawers seem oblivious to the fact that their tops must contain more short fiber and are therefore less valuable for spinning purposes. Flyings, rubber waste, sweepings, and slubs will naturally increase, the yarn will not be so smooth, nor as even, and the yield of yarn on top may be lowered if they continue to use ordinary gill boxes.

We have actually processed a 100% French-combed top on four-inch drawing and three-inch spinning, but we used intersecting gill boxes. The yarn was somewhat uneven but it was not slobby. We strongly advise and favor the use of one and one-quarter inch diameter spiral-fluted front rolls on fine gill

boxes for open drawing, say for 56s and finer, using tops combed in mills using intersecting gill boxes before the comb. In fact, all fine wools would produce more even yarns if this were done. Some mills are already equipped with small front rolls, others are trying intersecting gill boxes. One gilling, using intersecting gill boxes, will yield a better-blended, better-gilled, and whiter-looking sliver than two gillings on an ordinary gill box using large-diameter front rolls, two or two and one-quarter inch diameter.

Special Sliver Guide

We note that you are blending a short top with a longer top. If your slivers lead-in side by side you would obtain better results if the slivers could be opened somewhat and overlaid. A special guide can easily be made which will take care of four to six ends, which we illustrate herewith.



Sliver Guide for Gill Boxes

We do not know who originated this guide but it gives very good results for colored mixes and we recommend it as worthy of a trial when a short dry top is to be blended with good staple tops. If a short top is fed side by side with other slivers it is located in one narrow place in the faller. If it is laid between good staple tops and spread across full width of stock in pins, the good staple helps to control the short staple, so that a more intimate mixture of the blend is possible.

Regarding the addition of oil, if you add 2½%, and 40% of blend is dry top, you probably have about 4% oil in the roving. This is based upon 60% oiled top, which has 2½% of oil in it, being used in the blend. We believe that so much oil will increase your troubles because the oil added at can gill does not become equally distributed until a later process. A trial with less oil would soon prove whether this is so or not.

If the short dry top is eliminated from the blend your drawing layout is satisfactory, although we would use the 5.5 draft on the heavy drawing and ease the drafts on reducer and rover. We note that you use three gillings. If they are all ordinary boxes, two-inch diameter front rolls three-eighth inch pitch, we advise the omission of one process of gilling whenever a short top is used in any blend, also a

reduction in draft to about 4.5. We would like you to try the layout at Table 2, using one end in four at can gill of the short dry top No. 89, and equipping gill boxes with special sliver guides. Notice that two gillings only are given and one operation is omitted.

The drafts given will be actually increased 3% to 3½%, due to contraction of end on boxes where flyers are used.

Summary

(1) No. 89 and No. 56 contain an excessive amount of short staple.
(2) Percentage used in blend of short top is too high.
(3) Drawing layout not suitable for blend. Too much gilling and excessive draft.
(4) Gill boxes are not adapted for handling very short staple.

MAKING NUB YARN

Technical Editor:

Enclosed find a sample of Scotch tweed cloth. How can this spotty or nub effect be obtained on woolen yarns? Any information on this will be greatly appreciated. (6886)

The nub effect in the tweed cloth is obtained by the use of a nub machine on the card, which distributes or feeds the nubs into the stock during the process of carding. The machine is generally placed over the last two workers of the second breaker, or over the first two of the finisher facing the feed. All of the workers except one from this point on are raised from their points of contact with the stock to prevent carding out the nubs. The machine can be adjusted to deliver more or less nubs as desired.

Another practice sometimes followed is that of mixing the nubs into the batch when it is being laid down for picking. However, this method does not work out as very practical, owing to loss of nubs from droppings, and carding out. The roving should be made light on the card to allow a long draft in spinning.

UNSHRINKABLE PROCESS FOR WOOL JERSEYS

Technical Editor:

We are dyeing a large number of wool jerseys, a small sample of which we enclose. One of our customers is complaining that this cloth shrinks, and is asking us if there is a process of making this type of cloth practically unshrinkable. If you know of a process of this nature, would you be so good as to advise us what the formula is? (6942)

To make wool jerseys unshrinkable, the following process

is used with considerable success: Load the cloth before dyeing into a clean dyeing machine and treat as follows: The cloth is saturated with a solution of muriatic acid of 1.5° to 2° Tw. strength, and is then worked in a cold solution of bleaching powder, containing not more than .6 gram of available chlorine per liter, for about 20 min. After washing well with cold water, the chlorinated cloth is soaked in a cold solution of hyposulphite of soda of about 1% strength. Run in this until no chlorine is present in the cloth, as shown by a starch-iodide test. This cloth is further washed with cold water, and finally treated in a weak soda-ash bath for 5 min.; then again washed with cold water for 10 min.

Dyeing & Finishing

DYEING FULL-FASHIONED HOSIERY

By Farber

The fashion in hosiery now demands the sheerest of fabrics, the most flimsy material. For this reason, the hosiery dyer must exert great care both in the dyeing process and in the preceding operations. To prevent chafing and rough spots in the hose, the use of bags for boiling off and dyeing is recommended. The selection of the proper mesh bags is also important; probably the best way is to use a muslin bag inside a coarser laundry bag, not too large and yet large enough to insure to the goods ample room so the dye has a chance to penetrate properly. Two dozen pairs of service weight or three dozen of the chiffon weight are about the proper amount for each bag.

After a lot is bagged, it is ready to be boiled off. Different opinions prevail as to the best medium to use in boiling off. Olive-oil soap, tallow soap, olate soap, red-oil soap, sulphonated castor oil, and numerous other boiling-off preparations each has its advocate. This writer's experience is that the best way to boil off hosiery is first to select a soap or an oil that will dissolve and discharge the sericin in the silk in the shortest possible time and is easily washed out of the goods.

Methods of Boiling Off

A bath is made up of 25% soap or its equivalent of boil-off oil calculated on the amount of silk in the hosiery and 2% of Oakite or some other mild alkali to help dissolve the throwster's softeners and the knitter's lubricants. For the fine-gauge hosiery which is likely to show sleaziness in the knitting it is advisable to prepare the boil-off bath with all the ingredients carefully dissolved, enter the goods at 120° F., soak them for a few hours at that temperature or, if possible, over night. If there is a tendency towards distorted loops in the knitting, the warm soaking will swell up the sericin without discharging

it and keep the loops in position long enough to hold their shaping; by following this method sleaziness will be reduced to a minimum, if not entirely eliminated.

After soaking the same bath is brought to a boil and boiling continued gently for 45 min. or one hour. A prolonged boiling may result in weakening the fiber and, with the proper amount and quality of detergents, is unnecessary.

Some manufacturers are using boiled-off silk in splicing over the reinforced parts necessary in a well constructed hose, but that also is unnecessary when the boil-off is thoroughly understood, and no part of a hose should be knitted so thickly as to impair its look.

When the goods are well boiled off they must be thoroughly washed. Three warm waters are necessary. The first rinse should be at a temperature of at least 140° F., there being so much soap in the goods at this time there is no danger of the soap breaking up in this water, but is gradually washed out of the goods. In the second water a small amount of a mild alkali is advisable, especially when soft water is not available. Soft water, however, is prime requisite in any dyehouse that aims to produce first-class work. The goods are run about 20 min. at 120° F. and then given a final rinse in water at the same temperature or a little lower. Cold water is ineffective in washing soap out of the goods. Too high a temperature in the last rinse may break up what little soap remains in the goods and impregnate them with little specks which may show up in the finished product in small greasy spots familiar to all hosiery dyers.

The well-washed goods are whizzed in the extractor and are then ready to be disentangled and straightened out, after which they are put in the colored bag in which each color is dyed.

Making Up the Dye Bath

Dyeing may be done in circular dyeing machines or in paddle machines. When dyeing in a paddle machine the bath is prepared first, the goods then entered, the bath brought to the boil, and dyeing continued until the lot is dyed to sample. With a rotary dyeing machine, of the drum type, the goods may be entered first, the vat filled with water up to the shaft supporting the drum and steam turned on. In either case, to insure proper penetration and even dyeing, some dye aids are usually added to the bath at the start. A few ounces of Tetracarnit or some similar product and 1 or 2% of Turkey-red oil is recommended to prevent the formation of greasy particles and keep them in solution, also to retard absorption of dyestuffs and insure level dyeing.

As a rule direct dyes are used in dyeing cotton and silk hosiery. Those colors are selected which give as nearly as

possible the same shade on both fibers. Some dyes, however, which dye the silk darker than the cotton should not be condemned on that score alone. An addition of 1% of phosphate of soda to the bath at the start will make it slightly alkaline, retarding the adsorption of these dyes by the silk long enough for the cotton to take it up, and in that way much better results are obtained.

The proper amount of dyestuffs carefully weighed and dissolved are entered now through a fine sieve, the bath is raised to the boil, kept boiling for 30 min., then the steam is turned off, from 5 to 40% glauber salt is now put in, and dyeing continued for 20 min. longer.

The writer has heard of a lot of complaints about cotton tops, heels, and toes coming out uneven in what are called tiger stripes and the like. Mercerizers and cotton spinners are often blamed for defects, such as thick and thin places, uneven mercerization, uneven twist. If the dyer would take care to boil his goods in the dyebath at least 30 min. before adding any salt to the bath and use a good grade of Turkey-red oil, many if not all of those defects would disappear from his dyeings.

Dyebath Assistants

The amount of glauber salt is calculated on the quantity of dyestuff used. As a rule, when less than 4 oz. of color is used, 5 lb. of salt is sufficient, for 100 lb. of goods; from 4 to 8 oz. of dye, 10 lb. of salt is needed; for dark shades, requiring 5% or more dyestuff, a higher amount is necessary.

After working the goods in the cooling bath 20 min., from 1 to 2% of acetic acid is added to exhaust the hosiery dyers this addition of acid to the bath may seem not only unnecessary but positively harmful. They claim that at best it is a very hazardous practice, and this writer has had many ask him if the dyeing did not come out streaky. It does not. If everything has been carried out carefully as outlined above, when the acid is added the bath is in a nearly exhausted condition, the cotton is well colored and the silk only partially so. The acid increases the affinity of the silk for the dyestuff, also reduces the affinity of the dyestuff for the cotton at a time when this already dyed, or should be, to the proper shade, and providing the bath is not too hot, what little color remains in it will slowly and evenly go on the silk. This is not a theory, but a well tested procedure. When thoroughly understood, it will be seen that with a well-balanced formula and the operation carried on with care, the dyeing operation becomes much simpler and more easily controlled. If the cotton is dyed too heavily, a little more acid will reduce it and make it go on the silk; as it reduces slowly and it is taken up by the silk as it comes down from the cotton, there is no danger of uneven

dyeing. On the other hand, if the silk happens to be colored too heavily, a reduction of the acidity of the bath will remedy that situation. When necessary, a little sodium phosphate may be added to the bath to lighten the color of the silk. In some cases, with the bath only slightly acid, an extra boiling will make the dye penetrate farther into the fibers and help leveling the shade.

Finishing the Dyed Hosiery

With a well-balanced formula and the dyeing operation carried on carefully as outlined above, a good match may be assured time and again without any addition of dyes to the bath. Any touchings-up of the shade when necessary may be done in the same bath or in the final finishing rinse. The bath is dropped, the goods rinsed, and in a second rinse a little acetic or formic acid is added, if scroop is desired. In this bath some touching up of the shade may be done with acid colors. For this purpose Fast Red, Azo Yellow, Fast Silk Yellow, Silk Orange, Alpha-Azurine, Acid Green, Wool Violet are some of the colors that can be used singly or mixed with one another. They all go on very level, and a small amount of any of them will be found quite effective. Any thickening or sizing preparation to stiffen the goods may be added in this last bath, and without any further washing the goods are hydro-extracted ready for the boarding room.

Goods coming from the dyehouse to be boarded should be finished as soon as possible and not later than the following day. As they are delivered in a damp condition, if allowed to remain so for any length of time, they are liable to mildew and damaged goods may result.

MERCERIZING RAYON-COTTON PIECE GOODS

By D. G.

Mercerizing of rayon-cotton goods is an operation which has been adopted by only a relatively small number of finishers. This fact is due partly to the supposed dangers latent in the process and partly to lack of knowledge of procedure and costs. One has vivid and often painful memories of the action of even dilute alkalis when first these goods were handled, especially in the case of acetate rayon; but with increasing experience and knowledge it has actually become common practice to kier boil certain types of viscose-cotton goods.

Reason for Mercerizing

Mercerizing of this material is not carried out with an idea of altering the intrinsic properties of the rayon, but to give

an enhanced appearance to the warp—often of ungassed, single-ply, carded cotton. The bare, lifeless, and hairy appearance of the warp threads, in contrast to the smooth, rounded, lustrous, and transparent appearance of the rayon filling, is often accentuated when the material is dyed in heavy shades. This divergence is particularly apparent in navy blues, where—unless certain recommended dyestuffs are employed and great care exercised in their application—the cotton warp assumes a lighter shade than the rayon. In certain extreme cases the writer has known the fabric to exhibit an undesirable grayish bloom or cast.

Mercerization is employed to render the cotton more lustrous, transparent, and smooth and also to create an increased affinity for direct colors; the cost of mercerizing is often balanced by the saving of dyestuffs in heavy shades. A further advantage obtained by mercerizing this material is that rayon of varying affinity after mercerization undoubtedly absorbs direct colors more evenly.

Effect of Caustic Soda on Rayon

Caustic soda of the usual mercerizing strength has little appreciable effect on regenerated-cellulose rayons; but when the caustic is washed off with cold water, the rayon fiber swells tremendously, becomes more or less delustered, and partially dissolves; on drying, it becomes brittle and harsh. It has been found, nevertheless, that regenerated-cellulose rayon is soluble in caustic soda, and that this solubility increases from a minimum at dilute concentrations to a maximum at around 20° Tw., with a rapid decrease in solubility as the concentration increases above this. In addition, cold solutions of caustic soda have a more harmful effect on regenerated-cellulose rayons than have hot solutions of the same concentration.

Several methods of modifying this deleterious action have been suggested. Some of the more important of these are as follows: (1) U. S. patents of a few years ago covering the inclusion of such substances as phenol and glycerin in the mercerizing liquor; (2) Use of caustic potash instead of caustic soda, as the former has considerably less swelling effect on regenerated cellulose rayons; (3) Use of hot water in washing the material free from caustic soda; (4) W. Marshall's English patents 323, 307, 323, and 345 covering the use in the wash water of potassium or sodium chloride, sulfate, nitrate, or chlorate; sodium thiosulfate; ammonium chloride or sulfate; sodium thiosulfate; ammonium chloride or sulfate; sucrose, glycerin or glucose; and (5) Use of unbleached, undesulfurized fiber to minimize damage to regenerated-cellulose rayon.

Use of phenol, glycerin, etc., in the mercerizing liquor, while it protects the rayon, was found to be impracticable on account

of the high cost of materials and the difficulties encountered in recovering and reusing the caustic.

Use of Caustic Potash

Use of caustic potash, though its cost is $7.05 per 100 lb against $3.35 per 100 lb. for caustic soda, is not so expensive as it would seem at first sight. With up-to-date mercerizing machines it is usual to recover around 83% of the caustic soda used in mercerizing. This applies equally to caustic potash. There is one point against the use of caustic potash, and that is that most bleacheries use their recovered mercerizing lyes for kier boling, so that the high cost of the potash salt would prohibit its use unless the recovered lye is used to replenish the mercerizing liquor. Where all-cotton as well as rayon-cotton goods are being mercerized, use of caustic potash necessitates either a separate recovery system or employment of caustic potash for mercerizing the cotton goods. There are, however, objections to both of these methods.

Formula for Caustic Potash

To obtain the same degree of mercerization with caustic potash as with 56° Tw. caustic soda, it is necessary to use the former at 70° to 72° Tw., containing 36% pure potassium hydroxide. The following figures were obtained with 4.85-yd fabrics:

Material mercerized	24,952 yd.
Total caustic potash absorbed	1,782 lb.
Total caustic potash recovered	1,481 lb.
Total caustic potash used and lost in process	301 lb.
Cost (for material only) of mercerizing with caustic potash	$21.22

Caustic Soda

In the regular mercerization with caustic soda of 56° Tw and washing off with a 10% brine solution, it is assumed that the material after leaving the mangle (which generally has an expression of 100%) will absorb its own weight of caustic soda at 56° Tw. (25% pure sodium hydroxide). In order to prevent swelling and consequent disintegration of the regenerated-cellulose fiber it is essential to reduce the strength of this caustic soda below 20° Tw. as quickly as possible; it is found to be satisfactory to reduce it to about 15° to 16° Tw. This is accomplished by washing the material with 2½ times its weight of 10% brine, then with hot water, and next with cold water.

Formula for Caustic Soda

For 24,952 yd. at 4.85 yd. per lb. this will necessitate the use of about 1,300 gal. of brine containing 1,275 lb. of salt, or

which about 40% is lost in process. Furthermore, instead of 83% efficiency in the recovery system about 75% only is possible with this method. The results obtained by this method are as follows:

Total caustic soda absorbed	1,237 lb.
Total coustic soda recovered	928 lb.
Total caustic soda used and lost in process	309 lb.
Cost of caustic soda	$10.35
Total amount of salt delivered to system	1,275 lb.
Total amount of salt recovered from system	765 lb.
Total amount of salt used and lost in process	510 lb.
Cost of salt at $0.70 per 100 lb.	$3.57
Total cost of materials	$13.92

Caustic Recovery

When the caustic-soda-brine washings are recovered and concentrated, it is found that the salt gradually separates out, being almost completely insoluble in concentrated solutions of caustic soda. About 2% to 4%, however, remains in solution, but does not effect subsequent mercerizing adversely.

It has been found that the counter-current system of concentrating the caustic-soda brine washings, whereby the dilute solution is sprayed on and sucked through the cloth while in the clips, cannot be applied to this method; for at some position in the tenter the cloth is bound to be saturated with 20° Tw. caustic soda, with consequent swelling and disintegration of the rayon. Use of hot water for washing after mercerizing is infinitely better than cold water, but does not entirely eliminate the swelling of the rayon and subsequent loss of softness, strength and luster.

These methods are applicable only to rayons of the regenerated-cellulose type, but they are particularly beneficial to cuprammonium rayon. As a rule, this latter type has the greatest affinity for direct colors of all the regenerated-cellulose rayons. If union goods of cuprammonium rayon and cotton are mercerized as described above, the affinity of the cotton approaches that of the rayon sufficiently to enable the goods to be dyed satisfactorily, and so avoid such troubles as were mentioned at the beginning of this article.

Acetate-Rayon Fabrics

Mercerizing of cotton unions containing acetate rayon presents quite a different proposition to the finisher. The action of caustic alkalis in general is to saponify acetate rayon either partially or wholly according to the severity of the treatment. It is well known that hot caustic soda solutions effect this saponification more readily than cold ones of the same concentration; but what is not so well known is that concentrated solutions have less action than dilute ones. This is probably explained by the fact that acetate rayon is penetrated with diffi-

culty by water solutions; and the more viscous these solutions, the less penetrating they are. Statements have been made that acetate rayon is not saponified by caustic soda of mercerizing strength. Actually, there is always a slight amount of saponification of the acetate rayon to form cellulose; and prevention of subsequent swelling and solution of this cellulose presents two main problems.

From results obtained by washing viscose-cotton fabrics impregnated with 56° Tw. caustic, it will be obvious that washing caustic-impregnated acetate rayon goods with cold water will cause swelling and solution of the small amount of regenerated cellulose caused by superficial saponification. On the other hand, if hot water is used for washing, there woud undoubtedly be a tendency to prevent swelling and solution of the slight amount of cellulose caused during impregnation with 56 deg. Tw. caustic soda; but hot water in combination with the caustic soda extracted from the material causes saponification of the acetate rayon.

The obvious remedy, and one which is proving entirely satisfactory in practice, is to wash the caustic-impregnated fabrics containing acetate rayon in 10% cold brine, and thus prevent disintegration of the small amount of cellulose regenerated by saponification during impregnation.

Use of unbleached rayon in these unions is recommended because all bleaching operations tend to produce oxycellulose, which is soluble in the caustic soda.

PRECAUTIONS IN DYEING CREPE-BACK SATINS

By W. Gordon Young

Dyeing of crepe-back satins, of which the satin is acetate rayon and the crepe real silk, presents a number of difficulties not ordinarily encountered in the dyehouse. In fact, it is not advisable for any dyer to start work on fabrics of this type until he has had some practice in processing pure silk goods and those composed wholly of acetate rayon. While the experience gained in handling both of the latter types of fabric will prove invaluable, in dyeing crepe-back satins there will still be need for the utmost skill and judgment. Add to these facilities careful chemical control, and the expert dyer should be able to produce satisfactory results.

Crepe-back satins, since they contain real silk, must be boiled off or degummed previous to dyeing. This process, which is usually carried out in large boil-off vats similar to those used for all-silk fabrics, presents the first problem. While there are a number of boil-off compounds on the market which are ex-

cellent for degumming pure silk, it will be found that many of these cannot be used in an acetate-rayon mixture. If too alkaline a solution is used, the acetate rayon will be saponified, thus losing its luster and acquiring an affinity for direct dyes. High temperatures also must be avoided or the rayon will be damaged. On the other hand, the bath must be capable of properly degumming the silk.

Boiling Off

It will be necessary for each mill to determine what boil-off compound is the most satisfactory under local conditions of use. As a rule, however, olive-oil soap will be found to give excellent results. A solution containing 20 to 25 lb. of soap to 100 gal. and maintained at a temperature not exceeding 180° F. imparts no ill effects to the acetate rayon and enables complete degumming of the silk. The time required for the boil-off varies, and due to the low temperature of the bath, may be four, five, or even six hours.

The fabrics are usually treated in rope form, about 40 pieces being boiled off at one time. Two men, one stationed on each side of the vat, keep the goods in motion while immersed in the liquor. Care must be taken in handling the fabric while in the bath, as the acetate rayon is in a more or less plastic condition and may be damaged by rough treatment.

After the boil-off the fabric is partially dried in a centrifugal extractor. The goods should not be dried too thoroughly in the extractor; otherwise, creases may be formed which will be evident after dyeing and finishing. To reduce the possibility of creases some dyers prefer to run the fabric over a tenter after extracting and before dyeing. This procedure, however, is not usually necessary unless the extracting has been carried too far.

Dyestuffs and Dyeing

Crepe-back satins are dyed in reel machines, such as are ordinarily employed for crepes and similar materials. They are usually dyed in solid shades by the one-bath method, although cross-dye effects may be produced if desired. Special colors developed for use with acetate are employed for that fiber, while direct colors are used for the silk.

Since the satin is often bruised if the fabric is dyed on the winch in the customary way, it has been found best to have it prepared in a manner that will keep the face from touching the reel of the machine. To obtain this protection, the fabric is sewn all along the selvage with the satin face inwards, thus preventing the satin from touching the reel. The goods are then loaded on the machines and dyed in the ordinary manner.

Providing the bath contains sufficient soap, there is little trouble with uneven dyeing.

In the choice of the direct dyestuffs for the dyeing of the real silk in this type of fabric, particular care must be taken to assure that they are almost perfect resists for the acetate-rayon. It is often extremely difficult to get the desired shade on the face if the direct dyes are staining it. Therefore all dyes should be tested in the laboratory to make certain that they are suitable. During the processing of real-silk and acetate-rayon mixtures there are several things that the dyer must remember. Acetate dyestuffs, as he should already know, must be given their full time to dye properly—they cannot be rushed and get a true color or a shade that is fast to washing. It also is advisable to hold back considerably with the direct dyes; when the acetate silk is practically on shade, they can be rushed on by the addition of more dye or salt. Dye with a reasonable amount of time; that is the only reliable way to bring up to shade on acetate rayon and insure a proper result. Actual dyeing operations may consume from three to four hours, while the preliminary wetting out will require about twenty minutes and the final rinse another hour.

If a soft handle is wanted, and an emulsion or oil finish is given, this finish must be chosen with the utmost care; and only after having made extensive laboratory tests should it be used. There are finishes that alter the shade of the fabric, others that strip off dye and make the fabric streaky, and yet others whose deleterious effects do not show up for some time.

PRINTING VISCOSE RAYON FABRICS

By A. E. Hirst

The printing of viscose fabrics does not differ essentially from the printing of plain cotton goods, the principal difficulties to be avoided being merely a matter of detail. This article will deal largely with these details. Most of the attention required in handling viscose fabrics is the same basically as that necessary in their dyeing for plain shades, with the preliminary and finishing processes, but of course there are variations depending on the type of weave.

Preparing the Cloth

For certain of the more durable fabrics such as rayon alpacas, it is permissible to give the goods a mild boil in the kier, especially in the case of cotton-rayon mixtures. Preliminary malting and washing is carried out in the usual way. Of course

great care must be used in drawing into and out of the kier and through the other machines to prevent fraying and splitting. Heavy nips, such as are present in log washers, are to be avoided since small cracks which are difficult to detect may occur. By jacking up the upper bowl slightly, so as to give very light pressure, enough tension may be exerted to furnish a pull on the cloth without damage.

When permissible, and this applies to most fabrics to be printed, it is policy to give the goods a thorough malting, followed by a wash and gentle scouring in a reel machine with weak caustic soda solution and soap. After rinsing and extracting, opening and drying, the cloth is ready for dyeing or printing. In many cases treatment with chlorine is unnecessary where the gray goods are fairly white, and large areas of white ground do not show in the print. When subjected to kier-boiling, the boiled-out goods may be rinsed and chemicked while lying in the kier.

Further details as to bleaching are unnecessary, as they are identical with those which hold for plain dyed fabrics. The material is now ready for dyeing in the usual way, for preparing with the ordinary naphthols, or for printing as unprepared white grounds.

With the present tendency toward bright red, orange, and gold, many of the rayon goods must be prepared, the better fabrics with the newer types of naphthols. This type of preparing may be done by slop-padding with a mangle composed of rubber and brass bowls, with a minimum amount of threading up. The operation may be carried out by batching and subsequent drying, or by padding and direct drying on a tenter frame. Where blistering on a dry-can set is encountered, the goods are padded, passed some distance above the cans, and when thus partially dried, are threaded on the cans in the usual way.

Handling All-Rayon Voiles

Depending on the type of pattern to be printed, the cloth may now be wound and sent direct to the printing machine or, when check patterns are involved, they receive a preliminary straightening on a 90-ft. or short frame. It is simply necessary here for the operator to avoid fraying. Since there must be some tension on the frame for the carrying out of this process, some fabrics will be successfully framed only if the original scouring has been properly done. Too drastic treatment, especially in the rope form, will shrink certain portions to such an extent that they will split in the framing. This applies particularly to all-rayon voiles, where changes in the filling bring about variations in the ability of the piece to withstand stretching. For these fabrics, scouring in the open state is advisable.

Crepes are ordinarily merely scoured after creping, and must have been carefully tentered free from scrimps when ready to go to the printing machines, otherwise exceptional care must be used in running over spreader rolls to avoid misprints.

Colors Used on Viscose

The printing colors used in viscose, and viscose and cotton mixtures, are generally identical with those for plain cotton. Basic dyestuffs, vats, and the fast naphthol colors are commonly employed and are after treated in the same general ways as used for cotton. The use of aniline black is attended with some danger, and it is questionable whether this color should be printed. While some success has been met with, at times a dangerous tendering condition has been encountered, and it has proved advisable to use the more expensive but more reliable vat or fast naphthol blacks.

Scrimp-bars on the printing machines should be avoided, and rollers substituted to avoid fraying and the displacement of the rayon figures. Particularly in the case of crepes, care should be taken to use as little tension as possible on the goods as they are drawn from the nip to the dryer. This holds mostly where heavy blotches are used, as under heavy tension there is a tendency for the crepe to flatten in its moist state. Air dryers or cans may be used as desired.

In the case of hydrosulphite discharges and vat colors, the goods now pass to the agers. Here again the utmost care must be used to see that there is no undue tension in the box or on the draw rollers outside. A very good type of machine is now available with roller bearings on all the rollers, many of the latter being driven. The goods may be easily drawn out without their being crushed in a nip. Ageing conditions, such as temperature and moisture, are as usual.

Varying degrees of soaping are used, depending of course on the type of colors used, and the usual precautions are observed with respect to draw rollers and scrimp-bars. It is advisable to use some type of compensator between open-soapers and dry cans. Where the reel washer is not available for rope soaping, the regular log washer may be used, but the upper log must be raised enough to eliminate the crushing effect of its heavy weight as described under bleaching. It is, of course, best to provide a reel machine in which such danger of damage is eliminated. The goods are then extracted and may be dried by air or over cans.

We need not dwell here on the subject of finishing rayon fabrics, which has been discussed in detail in other articles devoted to this branch of textile finishing. Finishing of prints is similar in principle and detail to the finishing of other fabrics made out of rayon.

FINISHING PLAIN AND JACQUARD COTTON VELOURS

By M. A. Beckoff

The appearance of finished velour depends to a great extent on the preliminary processing. When the processes have been handled carefully, a satisfactory finish is more easily realized. At random I mention a few precautions to be taken in the preliminary processing.

When preparing the warp it is necessary that all ends on a beam should have uniform tension. This may be accomplished by uniform regulation of whatever apparatus a particular mill uses. Proper tension avoids such imperfections as light streaks and uneven pile lines. Pile bars, choppy pile, or staggering pile (by which is meant the shifting to one side of pile yarn under the warp) should be avoided. When these faults occur, imperfect finishing naturally follows, as the higher and lower fibers show up to a degree no matter how the pile is laid or how much of it is sheared off in attempting to even it.

Precautions in Dyeing

The dyer should study the chemicals and dyestuffs employed under various conditions of use in order to ascertain their effect on the different fibers involved; and he should strive to get a fluffy, pliable fabric which can be perfectly finished. He should also take particular care to see that when pieces are put into the kettle, they are put in with the pile, instead of against it.

It is a well-known fact that lack of coordination between the warping, weaving, and dyeing is the greatest cause of difficulties in the finishing. Many plants operate with departmental heads who do not understand very much about any department with the exception of their own. By the time the goods are finished every imperfection is magnified, and naturally when there are seconds, the finisher is blamed because his is the last process involved. From my personal experience in processing pile fabrics, I believe that almost 90% of the finishing difficulties can be overcome by having some one person in the plant who thoroughly understands all of the processes involved, and who is able to analyze gray goods, and detect any imperfections before they reach the finishing departments. This would eliminate to a great extent the loss due to seconds caused by faulty production on looms, and it would eliminate as well the necessity for constantly changing the finishing equipment to meet these imperfections.

Actual finishing of cotton velour is governed by the purpose for which the velour is intended. For instance, velour required for upholstering purposes is treated in the following manner: After dyeing, the piece is put over a vacuum extractor in order

to extract the excess water. In some plants, the extractor is so arranged that the operator can guide the piece through evenly; and in this case the goods may be fed automatically onto a pin-tentering and drying frame. Here the piece is dried and stretched to the desired width. Sometimes the pile is brushed on this frame. In some plants the pieces are tigered immediately after being taken from the extractor, while they are still wet. This last operation, I have found unnecessary.

The next operation is dry tigering. There are many different types of machines built for this purpose. However, they all follow the general principle of having a wire brush, revolving at about 2,100 r.p.m., striking the threads and breaking them up into individual fibers. After tigering the fabric is sheared. In this operation all of the fibers are evened up and clipped to uniformity.

Some mills after shearing use oiling or waxing machines, which are constructed with large heated drums and brushes. When the velour passes over the compartments where the chemicals are applied to the pile fibers, the brushes spread these chemicals and the drum dries and polishes the face thereby bringing out the luster. About 95% of the mills follow this method, but the same result can be obtained by getting a lustrous fiber in the dyeing.

Jacquard Velour

Jacquard velour is treated in a slightly different manner from the method described for upholstery velours. In the majority of mills where multicolors are used, the yarn is dyed first and the piece next goes through a scraping machine which takes out the floating pile threads. The material is then ready to go over a tigering machine, next through the shearing operation, and finally through the oiling and waxing process. There are a few mills manufacturing high-grade jacquard velours that treat the fabrics with chemicals before dry finishing to obtain a velvety lustrous fabric. In this case, fast dyes must be used, as otherwise the colors would run, thereby damaging the goods.

DYEING VAT COLORS ON SILK

By Raymond Curtis, M.Sc., A.I.C.
Manager, Quidnick Dye Works, Inc.

The silk dyer, in common with every other class of dyer, is continually being pressed to dye faster colors—particularly colors that the manufacturer, converter, or retailer can guarantee as "fast" and which are replaceable in case of fading. It is obvious that the ideal to be aimed at in any guarantee is absolute fastness of color to all agencies to which the fabric

can be subjected. While there are very few shades dyed that reach this ideal, selected vat colors on cotton materials very nearly approach it, satisfying for all practical purposes this demand for guaranteed fastness.

The plea from many quarters for vat-dyed silk is of course intelligible from this standpoint of a safe guarantee; and the question naturally arises whether it is not possible to solve the problem of by utilizing the vat colors and thus procure a superlative fastness. At present the silk dyer tries to meet the degree of fastness which is considered adequate for any particular purpose; for instance, no special light or washing fastness is given to silk for evening wear; tapestry is given light fastness, but no washing fastness; while in the case of tub silks a washing fastness to withstand soaping at 105° F. has been considered adequate. But now that the vat colors are available to give "guaranteed fast" shades, there seems no reason—to the layman at any rate—why their use should not be extended to silk in the same way as cotton. The present article indicates some of the difficulties which beset the path of the silk dyer in his endeavors to this end.

Difficulties in Vat Dyeing

In the first place, it should be realized that a very large proportion of the silk used today is tin-weighted, which at once eliminates the possibility of its being vat-dyed. It is not that the vat colors cannot be applied, but all the difficulties of vat dyeing pure silk are so aggravated in the case of tin-weighted silk that successful dyeing on the large scale is practically impossible. Even if the difficulties of vat dyeing were successfully overcome, since the life of tin-weighted silk under the best conditions is relatively short, there would be no useful purpose served in applying expensive, permanent colors to a short-lived fabric.

In considering the application of vat colors to unweighted silk the manipulation of skeins presents no special difficulties, but in the case of piece goods the problem is a very real one. The usual type of silk vessel (Fig. 1) in which possibly 90% of all-silk piece goods are dyed is obviously very unsuitable for vat dyeing because of the long exposure of the goods to the oxidizing action of the air. But immediately one tries any modification of this machine and attempts to use, say, the wool type (Fig. 2) with only a short length of cloth exposed to the air the problems of level dyeing and fraying become acute. Even if these be satisfactorily overcome, the extraordinary difficulty of getting an even oxidation of the leuco compound when the goods are in the rope form makes any such methods of vat dyeing impracticable. Methods can be devised, such as the suspending of the silk from sticks in the degumming tank (Fig. 3), for keeping the fabric submerged at open width, but these

methods are very unproductive, and except for tints, extremely costly.

It is evident therefore that any development which will permit the use of the ordinary silk-dyeing equipment will be an important step towards solving the problem of vat dyeing silk piece

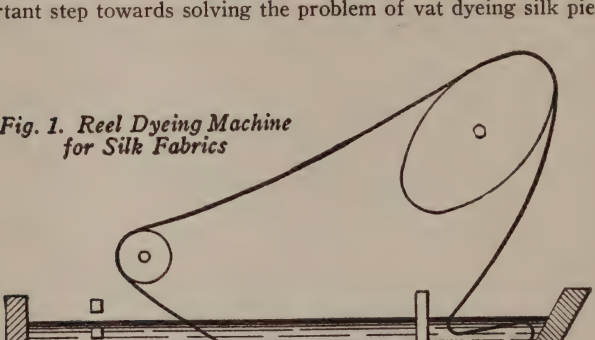


Fig. 1. Reel Dyeing Machine for Silk Fabrics

goods. At present the range of Indigosols is limited and includes vat dyes of inferior light fastness, but insofar as these dyestuffs can be applied like ordinary acid colors to the silk fiber they make the vat dyeing of silk piece goods feasible. Some silk dyers have condemned these dyestuffs (Indigosols) owing to the great difficulty of dyeing to shade, and it is of course a very risky business adding fresh dyestuff to the boiling dyebath or relying on the exhaustion of the bath to get the correct shade. But for pale and medium shades on some fabrics it should be possible to get satisfactory dyeings to shade by padding the Indigosols on the silk and then developing in the silk vessel. It might be thought possible to utilize this method for padding reduced vat colors on the silk, but the color value is very poor and the same difficulty of getting an even oxidation in the rope form presents itself as when dyeing in the rope form.

Where it is possible to run a silk fabric on the jig it is a relatively easy matter to dye with vat colors, but unfortunately there are not many all-silk constructions which are amenable to roller traverse. Owing to the elasticity of the silk fiber any variation in the tension brings about alterations in the fiber length. Local variations of tension due to slight differences in the fibers themselves, to the weaving, the jig rollers, etc., are

unavoidable and these invariably give rise to creases in the cloth and, consequently, streaky dyeings.

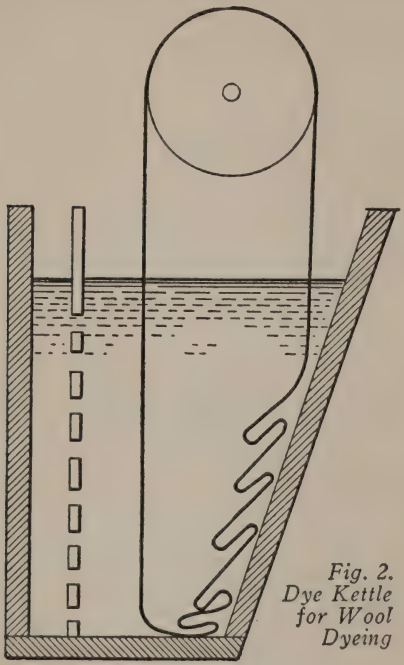


Fig. 2. Dye Kettle for Wool Dyeing

Production of Fast Shades

If, therefore, silk piece goods must have excellent washing fastness together with very good light fastness, it will generally be necessary to consider one of the following procedures:

1. Dyeing with Indigosols.
2. Dyeing in the degumming tank (or similar unproductive and costly method) with vat dyes.
3. Manufacturing the cloth from vat-dyed yarn.
4. Sacrificing some fastness and utilizing developed or other dyestuffs instead of vats.

So far the difficulties of manipulating piece goods have been considered, but there are many problems in the vat dyeing of silk which affect both piece and skein dyeing.

The problem of dyeing to shade is of course the same problem which faces every vat dyer no matter what the material he

is working on, but in the case of silk it is a far more serious thing to attempt to correct off-shade, streaky, or uneven dyeings, than with cotton. While the latter can be redyed several times, and if necessary, partially stripped without any serious injury, it is out of the question to subject the silk fiber to any such treatment without making it valueless.

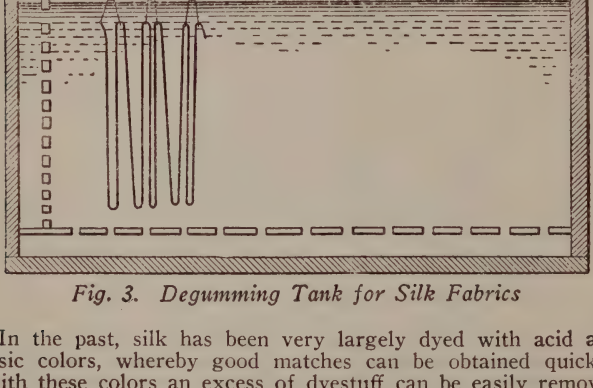


Fig. 3. Degumming Tank for Silk Fabrics

In the past, silk has been very largely dyed with acid and basic colors, whereby good matches can be obtained quickly. With these colors an excess of dyestuff can be easily removed by "thinning the liquor," so that the dyer is not obsessed by the fear of getting the shade too full. This quick dyeing in a slightly acid bath gives the brightest luster, preserves the fiber strength and in the case of skein silk minimizes winding troubles, setting a standard in these respects, which it is impossible to achieve with vat dyeing. Not infrequently the statement is made that silk can be vat dyed without loss of luster; and while in a quick dyeing the loss of luster may be negligible, yet in view of the well-known harmful effect of alkali on the silk fiber it is hardly to be expected that vat-dyed silk can equal in this respect silk dyed with the easier working acid or direct colors. For many purposes of course, the superlative fastness properties of the vat-dyed silk will quite offset any slight loss in luster, but this does not make the loss of luster any less real, and a dyer who imagines otherwise is living in a fool's paradise.

Strength of Vat-Dyed Silk

The effect of vat dyeing on the strength of the fiber is of course an important matter, and very divergent views have been held on the subject. The British Silk Research Association took up this question some years ago, and in two reports on the

"Effect of Vat Dyeing on the Strength of the Silk Fiber" (*B.S.R.A. Reports* 23 and 29), it was shown that a normal dyeing operation and one redyeing have little or no more deleterious effect on the tensile strength than an ordinary acid dyeing.

There are a number of products on the market for which is claimed the property of preserving the strength and luster of the silk fiber during its immersion in the alkali bath, probably the most widely used being Protectol. There is, however, considerable difference of opinion amongst silk dyers as to the degree of protection such agents afford, and they are certainly not to be regarded as having solved the difficulty of treating the silk fiber in a hot caustic liquor.

Various attempts have been made to avoid altogether the use of a strongly alkaline bath in the vat dyeing of silk. It is possible to decrease the alkalinity by the substitution, wholly or in part, of such substances as sodium phenate, naphtholate, etc., for the caustic soda.

This method, however, is not applicable to all the vats, and dyers who have tried it have had great difficulty in getting consistent results. The most promising field for getting vat shades without the use of caustic liquors lies in the development of the water-soluble compounds of which the Indigosols are the most important examples. (The Soledon colors are a similar class.)

From what has been written regarding the danger of injuring the silk fiber in the vat-dyeing process it will be readily understood that the type of silk and the nature of the yarn or fabric play an important part in the resistance offered to the development of "lousiness" and loss of luster. The wild silks offer the best resistance, and of the cultivated silks it may be said that in general, the better the grade, the more satisfactory it is for vat dyeing. This applies to spun silks also, it being almost impossible to get satisfactory results on the lowest grades of spun silk.

Cost of Vat Dyeing

In computing the cost of vat dyeing and comparing it, for example, with acid dyeing it is necessary to take into consideration: (1) The heavier cost of dyestuffs and chemicals; (2) the longer processing, with heavier labor costs; and (3) the risk of damage to the silk with a consequently higher proportion of claims and seconds.

The first item varies within very wide limits, depending upon the choice of color, the depth of shade, and the method of dyeing. Most of the dyestuff manufacturers issue cards showing their vat colors on silk, from which some idea can be obtained of the percentage required for any particular shade, but in the heavier shades it is never advisable to rely too much on these

for costing purposes, the only reliable way being to dye a lot of goods under the usual working conditions. Many of the best vat colors have too little affinity for the silk fiber to permit their use for anything but pale shades; thus a medium shade on organzine may cost over 30 cents a pound for dyestuff alone against 1 to 2 cents for a good direct or acid color.

The following list of dyestuffs includes some of the best working colors on silk together with those of good affinity suitable for the heavier shades: Anthra Yellow GC, Ponsol Brilliant Yellow 4G, Golden Orange 2RT, Brown AG and AR, Olive AR, Pink B, Indanthrene Golden Orange 3G, Brilliant Violet RK, Blue Green B, Blue RK, Rubine R, Hydron Orange RF, Helindone Orange R, Sulfanthrene Pink FF, Red 3B, Ciba Blue G, Cibanone Grey RN, Anthrene Jade Green. It is not the purpose of the present article to give specific instructions for the use of any of these colors, as these are furnished in the dyemaker's pattern cards, but it is possible to indicate in a general way the procedure which has given satisfactory results.

Vat Dyeing Methods

In the few cases where jig dyeing is permissible it will generally be found possible to use the same concentration of caustic soda (6 pints at 65° Tw. to 35 gal. dye liquor) and the same temperature, 110° F., for all the dyestuffs. The color, with the addition of small amounts of alcohol and soluble oil, is reduced and added to the dyebath in two portions—first and second ends. It is advisable to have about 1% Protectol No. 2, calculated on the weight of goods, in the dye liquor. Excess of hydrosulphite should be insured by using about 25% above the recipe quantities for cotton. After five ends on the jig the silk is oxidized without washing, in a bath of sodium perborate (2 oz. to the gal.) at 130° F. If a swatch soaped in the laboratory shows the shade to be too far away from the standard, the fabric should be washed off, and the procedure outlined above repeated with the fresh dyestuff. When a satisfactory match is obtained, the batch is soaped at 190° F. and finally washed.

In the case of hank-dyed silk, or silk suspended at open width, it is advisable to follow more closely the recommended conditions for each particular vat color as regards reduction temperature and concentration, temperature of dyeing, quantities of caustic soda and hydrosulphite, etc., since the ratio of goods to liquor is likely to be as high as 1 : 50 (as against about 1 : 8 in jig dyeing), and the question of getting full value from the color assumes great importance. However, for light shades a uniform concentration of caustic soda (6 pints at 65° Tw. to 100 gal.), and a temperature of 110° to 115° F. can be used with satisfactory results. In duplicating shades it is very important to maintain exactly the same

ratio of goods to liquor, this being as important as correct percentages of dyestuff. An addition to the dyebath of 1 oz. Protectol per gal. of liquor is recommended, since if the dyeing is prolonged in order to get a satisfactory match it will give some needed protection to the silk fiber. After dyeing to shade, the silk hanks are carefully wrung out, and hung for about 30 min. in the air. During this oxidation it is advisable to give the hanks a shake and turn. When oxidation is complete, the goods are rinsed and afterward soaped and brightened in the usual way.

FINISHING RAYON KNIT GOODS

Dyeing and Bleaching Do Not Present Difficulties of Former Years

Difficulties in the processing of the various rayons in the knitting trade are partly mechanical and partly chemical and physical. The mechanical difficulties may be further subdivided into manipulation and penetration problems; the manipulation problems arising from the fact that rayon will not withstand the handling that might be given to cotton. It should never be forgotten that rayon is considerably weaker than cotton and has greater elasticity when wet than when dry.

Uneven strains throughout the fabric, either before or after dyeing, causes such defects as are commonly known as "shiners" and streaky work from lack of uniformity in the absorption of the dyestuff. Friction in the dyeing of yarn or material made of rayon causes hairiness, which gives considerable trouble in rewinding and knitting; also in the goods a very poor appearance results.

Progress in Machinery

The dyeing equipment firms have made great progress in the machines now used for dyeing or bleaching rayon, and there should be no reason why a dryer, by the use of a certain amount of discretion, should experience any of the difficulties attributed to strain or friction. It should be borne in mind that in the dyeing, bleaching or finishing of rayon yarn or knit goods, the shortest possible procedure and recipes must be selected, as the longer the operation, the greater is the chance of fuzziness and strain defects in the fabric or garment.

Rayon yarn and knit goods cannot be wrung out like cotton after processing. The yarn before hydro-extracting must be wrapped in cloths and it is also very good policy to wrap each piece of rayon knit goods in cloth before extracting. This will prevent creases or friction marks which are very difficult to remove when once formed. In the drying of rayon, this fiber again shows its greater sensitiveness than cotton.

The effects produced by the action of heat on rayon are

extraordinary. A too high heat causes the rayon to become harsh and brittle, and this condition is not overcome entirely by conditioning. Wherever possible, in drying this class of material, the temperature should not exceed 130 degrees F., and the material should not be subjected even to this low temperature any longer than is necessary for its thorough drying.

Soft water should always be used for dyeing rayon and the addition of some of the new oils made especially for use with rayon will minimize the danger of friction. The beginner should experiment to determine how they work under the conditions at his mill. The recent practice of treating rayon with metallic salts for various purposes, such as to impart a greater affinity for certain dyes, and for delustering, causes the formation of insoluble sticky metallic compounds. Even today this is the cause of considerable trouble and loss to the manufacturers who attempt to remedy all evils in the dyehouse with soap. Among some of the defects attributed to this metallic soap deposited on the fiber or fabric are rancid odors, stains, uneven dyeing, as well as a dingy appearing fabric.

All in all, the problems in the processing of rayon and celanese in the knit-goods trade have been reduced to a minimum, and the dyeing or bleaching of these fibers is no longer looked upon with fear by the dyer and bleacher, as in former years. Practically all difficulties found in the mills today are due to local conditions which can be easily eliminated if gone after in the proper spirit.

Of late the trend in rayon tubular knitted fabrics has been for low-luster finish. The rayon manufacturers are able to produce yarn without the high luster, thereby relieving the dyer of the responsibility of trying to deluster rayon yarn himself. In most cases the delustering of yarn by the dyer has not been very successful, at the same time entailing expense and time for the operation.

Barre Effects Eliminated

One of the greatest improvements in rayon knit goods is the elimination of barre effects, which were so prevalent a few years ago. Due to the research work that has been carried out by the rayon manufacturers on this problem, we now encounter very little trouble with barre goods. They have not entirely disappeared, but it is only a question of a short time when the difficulty will be overcome.

The demand today is for fast colors, and it behooves the dyer to be very careful in selecting colors that will meet the approval of the public. The most important requirement for rayon knit goods is washing fastness. There are dyestuffs available on the market today that are reasonably fast enough for this type of fabric. Two classes of dyestuffs, namely, the direct cotton and developed colors, are largely used for dyeing rayon knit

oods. For light shades there are colors of the direct dyeing pe that have very good washing properties, and for medium id heavy shades the developed colors are suitable.

Dyeing Suggestions

The manufacturer or dyer who is interested in improving the ıality of his goods should consult with the dyestuff concerns ıd obtain the necessary information relative to the selection of estuffs needed for his purposes. We had the opportunity of eing a garment that had been trimmed in black, before and ter it was washed. After washing, the garment was ruined, far as color was concerned. The material that had been ed black did not stand the washing, and stained the rest of the ırment. If the dyer had had sufficient knowledge as to fast-ss requirements, and was familiar with the properties of his es, he could easily have produced a faster black, by after-eating his direct black with acetic acid and formaldehyde, or by ing a developed black.

Rayon knit goods, as it comes to the dyer, varies in width om 17 in. up to 26 in., and runs from about 80 to 90 yd. long. it is possible, it is a good plan to run all the same width pieces about the same length together in the dye kettle. Goods as they me from the knitting frames must be freed from the condi-ning oils that have been used during the knitting operation. the majority of cases these oils are easily removed by rinsing e material in warm water in the dye kettle. If it is found that the aterial is not clean after this operation, the cloth can be given a ght sour with 1% of neutral soap on the weight of the goods, or ecial detergent preparations used. The soap can be dissolved a clean half-barrel, or several pails, and added to the kettle. id goods run for 20 min. at 130 degrees F., and then washed oroughly.

The application of the direct colors is carried out under com-ratively simple methods for women's undergarments. The ades as a rule are very light. The dyebath is made up with e required amount of color and run at a temperature of about 0 deg. F. The actual time required for dyeing the light ades is comparatively short. Generally, one-half hour is ng enough to arrive at the shades. For most shades, the ldition of salt is not necessary, but in cases where it is needed, % of glaubersalt will be sufficient to assist the dyestuffs on the material.

Application of Developed Colors

The procedure for the application of developed colors requires ose attention of the dyer. As we have already said, these lors are preferred for medium and heavy shades on account their additional fastness properties over the direct color

types. The required amounts of dyestuffs and glaubersalt, or common salt, are added to the dyebath at 120 degrees F., material is brought up to 160 to 180 degrees F. in one-half hour, and continued at that temperature for one hour, after which a sample is taken and the goods washed off until cold, so that they may be further aftertreated to develop the shade. The sample taken at this time should be kept as a reference for future lots of the same shade.

In order to arrive at the true shade dyed with developed colors and obtain the maximum fastness, it is necessary to aftertreat. This is commonly known as diazotizing and developing. The material is run cold for 15 min. with 3% sodium nitrate and 5% sulphuric acid, based on the weight of the cloth. The sodium nitrate is dissolved separately, added to the kettle, and material thoroughly saturated before adding the sulphuric acid, well diluted. Five minutes is sufficient before adding the acid. After the material has run 15 min., it is washed thoroughly with cold water until all trace of the diozotizing solution is removed; usually 30 to 45 min. is required in washing off. The developing bath is made up, generally using 1% beta-naphthol and ½% caustic soda, based on the weight of the material. The beta-naphthol and caustic are dissolved togther by the use of hot water; boil if necessary. This is added to the kettle and the material run for 15 min. cold; then washed off thoroughly. After this operation, the true shade is obtained and the goods can be removed from the kettle.

To Gain a Soft Feel

If it is desired to add a soft feel to the fabric in either of the methods of dyeing, this can be accomplished by rinsing the goods in a weak soap bath; the writer prefers olive oil fig soap for this operation. The goods are run for 5 to 10 min. in the soap solution and removed without washing, extracted, and made ready for the dryers. Upright dryers are used with spreaders, according to the width of cloth desired. In general, it has been found that by drying rayon knit goods at a moderate temperature, more satisfactory results are obtained than by drying at high tmperatures—at the same time effecting a saving in coal. It is well to repeat this. After drying, the goods are passed through the calender and given a further steaming to improve the feel of the fabric. It is not necessary to pass the goods over hot calender rolls; excellent results are obtained by running the goods through with just the heat absorbed from the steaming.

BRIGHTENING COLORS ON RAYON

Technical Editor:

We are sending dyed samples of rayon. You will note that

there seems to be more luster on the powder blue and jockey red than on the buff and jockey red. The method of dyeing seems to be all right. We guard against high temperatures in dyeing and make the dyeing process as short in time as possible; also the stock seems to run uniform before dyeing.

Could you form any opinion as to what would cause this difference? You will note that the jockey red with the buff has a dead or dull appearance. We have been dyeing this class of stock in large quantities for other customers, but this is a new concern that we have recently started to do work for. The powder blue and jockey red were dyed by another dyehouse. Our opinion is that after the dyeing process they give the stock a treatment with some kind of emulsion to brighten same in the rinse bath.

Would you kindly look into this matter and advise us as to what your opinion is. If an emulsion is used, what would be the ingredient to use to form this appearance? Enclosed also find sample of white stock before dyeing. (6875)

The lustrous samples dyed powder blue and jockey red show the presence of a considerable amount of stainless mineral oil. This is very evident when the sample is wrapped in thin paper and kept under pressure over night. On in this form is applied after dyeing by giving it a bath in an emulsion made with soluble oil and some form of mineral oil, now generally called rayon oil. Some dyers have rooms where the oil is applied as a mist, produced by an atomizer, but either method will cause a temporary brightening of the colors. There is no remedy in the dyeing process except to use the most brilliant dyes obtainable, and to avoid too high temperatures in the dyebath, or the presence of strong alkalies.

RIPPLE BROADCLOTH CONTAINS FULLING-MILL CRACKS AND STREAKS

Technical Editor:

Will you please advise me as to the best method of finishing a piece of ripple broadcloth which is 18 oz. from the loom, 14½ oz. finished? The cloth is worsted warp and shoddy filling. My trouble has been fulling-mill cracks and streaks. I think the streaks are gig and water streaks. My method of finishing is as follows: Full with a heavy soap for 2 hr.; scour clean; nap, teasle gig; wet with plenty of water; carbonize and neutralize; dye; wet brush; and roll up for dryer, shear, brush, and press. Would appreciate any information in regard to this. Do you thing it is advisable to crab in the grease? (6887)

It is rather difficult to answer this inquiry, as the trouble may not come from the finishing processes, which seem to be

correct. The streaks may be caused by a too tight listing. This is a very common thing. The stock in the filling may be the cause. In making yarn for a ripple broadcloth, a quick fulling stock is used, and a stock that does not full easily. This gives the ripple. The inquirer may have used too much of the latter stock, which would cause streaks in fulling.

For tight selvages there is no remedy except a looser listing, but with the wrong blend the finisher can tack his pieces so that they will balloon in the washer and fulling mill.

Another thing that might help is to change the process of finishing by carbonizing and neutralizing before napping. The inquirer could determine then where the streaks are coming from by drying up a few pieces before napping, and inspecting them.

Crabbing in the grease would not help in this case as the finisher would only have trouble in getting his pieces clean. The oil in the stock would be pretty well set.

A finisher of these goods replies to the question as follows: I would suggest that you take your goods, after tacking with a small sitich, to the washer, load as usual, then add your fulling soap to the goods just as you would do if scouring. Use no water, soap thoroughly, and run about 15 min. Then take the goods to the extractor; extract as usual; then proceed to load fulling mill, sewing seams carefully and sewing up the side of the listings so as to make a complete bag of the piece. You may find it necessary to add a little soap, but be careful not to get the pieces on the wet side. When run about 15 to 20 min., you should note that the pieces are ballooning well. This will prevent breaks, wrinkles, or any other trouble that may be caused by your fulling methods. Scour in the usual method, then wet roll, say at 130 to 170°, and allow your goods to remain over night. Turn the rolls upside down, say at the end of twelve hours, to distribute the water evenly.

This treatment smooths out the pieces and leaves them in first-class condition for the napper or teasle, as the case may be. You can soon determine whether your trouble is fulling mill or gig streaks. Just dry a piece up before gigging and you will see the mill trouble. I feel sure that your trouble is before gigging. The rest of your process is quite in form and more careful preparing will avoid further troubles.

FINISHING CELANESE SATIN-FACED GOODS

Technical Editor:

Will you please give me information on the finishing of Celanese satin-faced goods, such as crepe-back satins, etc. Are these pieces sometimes finished on a rubbing machine with the application of a solvent containing a little oil? I would also like information on hand-rubbing methods. (6924)

The first requisite in finishing these goods is a little patience. Desize in a neutral soap and sulphonated castor oil at a high temperature, say 175° F. The temperature should be allowed at no time to go above 185° F. In using hard water, it is necessary to use soda ash in place of neutral soap. Dye with Celanese dyes.

Rubbing by hand is slow and not considered so successful as using rubbing machines. A light castor oil mixture is satisfactory for use in conjunction with the rubbing.

FABRIC FOLDS IN CARBONIZING

Technical Editor:

In running worsted and woolen cloths through carbonizing dryers, certain fabrics lap over on themselves more or less, causing folds. These folds cause an uneven drying and carbonizing action which results in a blotchy and streaked effect on the cloth. Some qualities of fabrics do not lap over. What causes this and how can it be avoided? (6841)

It is quite natural for wooden or worsted goods which have been through a number of processes in the wet state to be lapped over or wrinkled along the edges. One of the cloth guiders might correct the trouble. We sent the inquiry to two practical finishers, and their replies are given below.

The first reply is as follows: The inquirer does not state what kind of carbonizing machine he has. Perhaps it is a home-made one. If this is the case he had better put spreaders on his rolls, or have enough tension to keep his cloth straight and feed it in straight, making sure that all the rolls and the folder in the back travel at the same speed. The usual carbonizing machine works as follows:

The cloth is fed open into the acid tanks. It goes through spreaders up and down and comes through the squeezer rolls out of this tank. Then it goes into the dryer open width. It travels over rolls and is kept straight all the way through by even tension. The dryer has to be kept hot enough to bake the vegetable fibers. At the end of the carbonizing machine a folder spreads the cloth on a truck. If the cloth is always at the right tension from the acid tank until it reaches the truck at the back, there cannot be any overlapping. Perhaps the feed is faster than the take-off, and the cloth sort of backs up in the dryer. It is really hard to visualize the problem, not knowing the machine of the method used. But I am pretty certain that even tension will eliminate the trouble.

Another cause may that the rolls in the dryer over which the cloth travels are out of line. Some of them may be a little higher on one side which causes the cloth to grip the surface of the rolls more, or run off to one side, which might cause folds. This could easily be ascertained by watching the cloth

go through the dryer. If there are no windows on the dryer, the inquirer could run a few pieces through cold.

The second reply is as follows: We presume you are running the fabrics through a drying machine with rolls as a guide. There is nothing unusual about the lighter-weight goods giving trouble, and I would suggest that you try a little more tension on the cloth. Also run it through as fast as possible, being sure that the fabric is thoroughly carbonized. The overlaps or folds are caused by the cloth being allowed to run too loose, and when about dry allowing an excess to gather between the rolls; hence the overlap. The first few rolls on your dryer could be put under more tension by tacking a piece of leather on the end of the rolls and hanging a weight on them. The amount of weight to be used can soon be determined in the results as the cloth leaves the drying machine.

In addition, the following reply has been received from E. L. Smith, vice-president of The Philadelphia Drying Machinery Co., who is located at the Boston office of the concern: Several things might cause the lapping over of the cloth in the carbonizing dryers which the mill refers to. We would suggest, however, that it may be due to the following: Carrying rolls out of alignment; a blast of air on the edges of the cloth between the vertical centers of the rolls; or cloth with selvages more tightly woven than the body of the fabric. We would suggest that the mill check up and see whether the carrying rolls are all in alignment and of the same diameter.

If the air-circulating system is such that there is a heavy blast of air on the edges of the cloth between the vertical centers of the rolls, make some arrangements so that these edges are protected from the direct air blast. If it is possible, arrange the fans in such a way that the circulation is straight up or straight down through the runs of cloth.

If the trouble is caused by tight selvages, it will be found rather difficult to overcome, but this may be accomplished by using a series of suitable spreader bars at different points in the machine.

We hope this information will be of some service, and if the inquirer happens to be in New England, the writer will be pleased to call and take up these several points with him.

SHINE-PROOF FINISH ON WORSTEDS

Technical Editor:

Can you give me any information as to a method of obtaining a shine-proof finish on worsteds for men's wear? I am particularly interested in methods to reduce the tendency of serges to wear shiny. (6817)

The tendency to wear "shiny" is a characteristic of certain cloth constructions, and probably no successful methods are known to prevent it. In one mill a procedure for securing a

shine-proof finish on serges is as follows: The goods are fulled slightly, and in shearing a soft bottom felt is left between the lines of the twill. It is claimed that very little fiber between the lines of the twill will give very good results in retarding the shiny effect on serges.

SPOT-PROOFING WOOLENS

Technical Editor:

I would like to get all the information I can on the latest machine or process for spot-proofing kersey finish auto cloth, without taking away the luster. I understand there are mills today that are discarding the London shrinking process and using decating and semi-decating, which leaves the goods ready for the needle. (6951)

Few machines have been put on the market to spot-proof woolen fabrics. The process is slow and not always successful, it being necessary in some cases to subject the goods to three and even four treatments of wetting-out and drying to obtain results. By this process most of the press luster is removed, but a luster can be restored which is more acceptable to the clothiers by adopting subsequent processes which will be referred to.

The second part of the inquiry refers to the London shrinking process. This is a very old process which is used abroad quite extensively and in some of our American plants. Without going into details, it consists of first plaiting down the fabric with interposed layers of cotton cloth, submerging the entire body in water until it is well saturated, and then removing it from the tank. The fabric is festooned and dried to a large extent. Taken down from festooning it is placed between press papers and subjected to a heat pressing for several hours. After the first pressing, the fabric is removed from the press and replaited so that the fold or crease outside of the press paper is placed under the press paper for a second pressing.

This is an expensive process and does not always produce uniform shrinkage of the goods, certainly not a shrinkage that is acceptable to the best custom and commercial tailors. Some years ago, many plants that followed this method discarded it in part and introduced the so-called decating process. By this method the fabric is subjected to a steaming in a closed steamer after being wound with a wrapper or cloth interposed between each winding. This results generally in a very satisfactory feeling fabric. Frequently the clothiers subjected the fabric to a steam sponging on an open cylinder before the goods were cut up.

Later a machine was introduced which steamed the fabric when wound up on a special cylinder having tubes inserted in its periphery, the tubes pointing inward so as to prevent any water of condensation from coming to the fabric. A heavy

wrapper or mantle was used and wound upon the cylinder with the fabric, so there were alternate layers of fabric and wrapper. The mantle was subjected to considerable tension, while the fabric was wound as loosely as possible to make a smooth, compact roll, devoid of wrinkles. This fabric with wrapper was then subjected to a steaming from the inside and, after being properly steamed, was subjected again to a process of air removing by means of a vacuum pump drawing the air from the outside through the fabric until the cloth was practically cold. The amount of steaming and the amount of vacuuming were determined by the class of fabric and also the character of the feel that was desired.

This process produces a mellow feel, a permanent luster, and a reasonable, but not complete, shrinkage of the fabric. The fabric was acceptable to the clothiers and is in most cases ready for the needle. A few fabrics were obliged to be water shrunk and this is an entirely different process requiring equipment quite distinct from the process used in the lustering of fabrics.

We note that the inquirer refers to a decating process, evidently referring to the process of closed or chamber steaming. He also refers to a semi-decating process, and this last evidently refers to a machine sold under the name of a semi-decating machine, which is used to some extent to obtain luster.

The machine which we have indicated as a steaming and vacuum-cooling process machine is used by most of the large clothiers and has been installed in many of the better equipped mills. It is a machine which has met with the approval of the clothing industry. By varying the amount of steaming and the amount of vacuuming, it seems to be adapted to practically all the different classes of fabrics.

SILK

ADJUSTING THE WARP-PROTECTOR ROD ON SILK LOOMS

By H E. Wenrich

Of the many types of looms in the mills at the present time, most all employ the two principal forms of warp protection shown in the accompanying sketch. One type has the knock-off dagger pointed up, while the other has it pointed down. The working principles of the two types may be compared as follows: The knock-off dagger with point uppermost must be in such a position that the point will be worked downward to clear the knock-off lever while the loom is running; while the knock-off dagger with point downward must be worked upward to clear the knock-off block. The knock-off block is most generally known as the "side-protector bunting." One fits on each side of the loom and holds a small piece of steel called "side-protector bunting steel."

Fixing Not Difficult

While the two types of warp protection mentioned are often found in the same mill, the merit of each one rests with the fixer. Each fixer will undoubtedly favor the one giving him the least trouble, and will have a method of fixing it to suit himself. I use the type of warp protection which has the points up and must be worked downward. This type is found in many mills today. Although somewhat complicated in design, it is simple and easy to fix.

There are numerous principles involved in the perfect functioning of the warp-protector rod, but the warp-protection motion is really not a puzzling affair. Its very simplicity is one reason why looms can be run at high speed and made to turn out a high average of firsts. It eliminates many seconds due to shuttles pinching in the shed, smashes, and shirey cloth. Of these common defects, smashes are the most troublesome and the most expensive.

From observation and actual experience, I have found that a fixer can find a faulty protector rod at certain times while the loom is in motion. Many will not approve of all the methods advocated by various men, but fixers will find that, working from a practical angle instead of theoretical, the method explained in the following discussion will be satisfactory.

Just Enough Freedom

The warp-protector rod is secured to the loom by small castings which often form bushings for the rod. These bushings must be large enough to allow freedom to the rod without its being able to move up and down or front and back with a bouncing motion or with too much freedom. If, as is often the case, the rod sticks at times, the bushing must be filed down to make more freedom for it. A fixer will also find that at times the rod will be bent backward at the point behind the knock-off dagger. By bending the rod forward at this angle, he will give it a free and easy movement again. The protector rod at all times must be free in the bushings, in order that the spring tension will bring it back in place to strike the knock-off plate in the case the shuttle is not in the box.

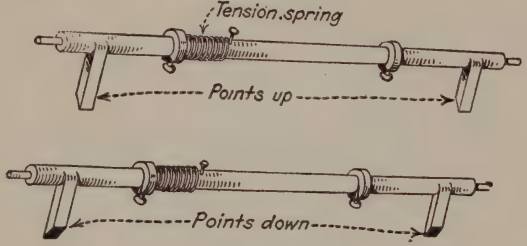
Although every loom must be fixed ar near like every other as possible, it will be found that no two can be fixed exactly alike. If such were the case, anyone could be taught the requirements of a loomfixer in a short time. The propensity of looms in requiring differing adjustments of various parts applies to a certain extent to the warp-protector rod, although the dagger points will be found to measure nearly the same on one loom as on any other of the same type. The warp-protector-rod spring might be slightly stronger on one loom than on another, and a slight difference in the distance between the dagger point and knock-off plate might show, but the distance of the tip of the dagger point from the rod should be practically the same on all looms of the same type.

With Two Knock-Off Levers

With the looms that have the two knock-off levers, but with only one used to stop the loom, it will be found of advantage to have the dagger point at least $\frac{1}{8}$ in. longer on one side than on the other. In this type of warp protection, the side of the warp-protector rod that knocks off the brake and shipping handle should be longer than the opposite side by this slight amount. This is due to the fact that the brake and shipping handle should be in motion to shut off the loom before the loom is subjected to the forceful shock caused by banging off. The dagger point on the side mentioned should also be slightly nearer to the knock-off lever. This can be adjusted by using some tool to bend the protector rod sufficiently to bring the dagger point to the position desired.

A feature of special interest is the use of a straightener for bending the warp-protector rod, instead of a monkey wrench; although by using a monkey wrench, one fixer can bend the rod correctly without calling another fixer for help. Plate a hammer or some other heavy object between the knock-off dagger and the breast beam. Then bend up on the opposite side to bring the dagger point to the desired position.

There are no standard specifications for exact measurements of the difference in length of one point from the other, so a fixer must use his judgment in this matter.



Two Types of Knock-Off Dagger

For making determination of the correct length of a dagger, a shuttle should be placed in the shed and the lay closed up so that the shuttle will be pressing up against the cloth while the dagger point is seated in the groove of the knock-off lever. If the loom is in this position and the shuttle is forcing the picks and cloth back tight in a strained manner, the daggers are too short. Every fixer learning his job should remember that when the shuttle is in the shed and the lay is brought forward in position to bang-off, the loom should bang-off with enough clearance in the shed to prevent the shuttle pinching the cloth.

Dagger Clearance

To secure the clearance that the dagger should have from the knock-off lever while the loom is in motion and the shuttles running, the shuttle should be placed in the box and the lay brought forward so that the dagger will be at the point below the lever. There should be here at least $\frac{1}{4}$ in. of clearance. If a fixer would measure this distance on all the looms in his section, he would find that this distance varies from $\frac{1}{8}$ to $\frac{1}{2}$ in., and that the majority of the looms are below the $\frac{1}{4}$ in. mentioned as suitable clearance between the dagger points and the levers. I find that in most cases $\frac{1}{4}$ in. is plenty, although it is up to the fixer to judge correctly the proper distance at this point.

If the points of the knock-off daggers become worn and rounded at the ends, the rod should be removed from the loom and dressed up correctly. If the knock-off levers or side-protector bunting steels be worn out, they should be dressed up or renewed with new parts at once. Only by constant attention will the fixer be able to keep his section up to date and turning out perfect merchandise.

ORDER OUT OF CHAOS IN SILK AND RAYON NUMBERING SYSTEMS

By Edwin J. Gibbons

Rayon and silk are numbered according to the Continental or denier system. That is, the weight in deniers of a certain (or rather, uncertain) number of yards equals the count or size. In the dram system, the system by which raw silks are numbered, the English yard and dram are used, but in the denier system the French *aune* (a measure of length) and *denier* (a measure of weight) are employed. To be specific, the formula for determining the count or number of any artificial silk reads, "The weight in deniers of 400 aunes equals the size."

The uncertainty suggested above arises from the fact that at the present time there seems to be considerable cloudiness enveloping the terms "aune" and "denier." Basing conclusions on information collected by the writer, it would seem that each rayon manufacturer has placed his own interpretation upon these terms and figured accordingly. A vague idea of the muddle which has ensued can be gathered by a perusal of a list of figures each obtained from a different source and purporting to be the number of yards per pound of No. 1 rayon.

4,437,333.3333
4,445,665.6896
4,464,528.0000
4,464,513.0000
4,464,471.1950
4,450,500.0000
4,463,424.0000
4,464,512.6400

To be sure, some of these are not widely different, but why any variation at all?

Webster's Definition

To further complicate matters, Webster defines "aune" (pronounced like our word "own") as: "An old French measure corresponding to the English ell and *varying in different parts*

of the country [the italics are the author's], being equal at Paris to 46.77 inches (1.188 m.)." The dictionary adds, "It has been superseded by the meter, but survives to some extent."

Note that the measure varies in the differnt parts of *one* country, to say nothing of three or four continents!

The same authority defines "denier" (pronounced de-nēr—short "e" on first syllable, long "e" on second syllable, and accent on second syllable) as "A Roman coil originally equivalent to ten asses. *a* Any of several old French coins, for the most part of small value. The original denier was a silver coin descended from the denarius. *b* A French money of account previous to the revolution, equal to one twelfth of a sou."

So, there you are!

D-13 to the Rescue

However, some effort is being made to straighten out the tangle. According to a tentative standard submitted at the 1926 annual meeting of American Society for Testing Materials by Committee D-13—the textile committee of the society—and later revised by the same committee in 1927, the denier of a yarn is the weight in grams of 9000 meters; and the yards per pound of any given denier equals:

$$\frac{4{,}463{,}528 \text{ (yds. per lb. of No. 1 denier yarn)}}{\text{Number of given denier}}$$

Only in isolated cases do these figures agree with the standards in use at the present time. But, among the membership of Committee D-13 are representatives of all of the largest rayon manufacturing concerns in the country. So it is reasonable to deduce that upon the acceptance of the proposed standard the entire question will be definitely settled.

If the report of Committee D-13 is accepted as written, then for the first time will be universally established a standard number of denires per pound; viz., 9072. This is not the first time, however, that this particular figure has been proposed, for one textile publishing house at least, has printed and advocated its use for some years.

Yards Weighing One Denier

Another figure that will be definitely established should the proposed standard be adopted is the number of yards of No. 1 rayon that should weigh one denier; namely, 492.12. This figure is determined by the equation:

$$\frac{4{,}464{,}528 \text{ (yds. per lb. of No. 1 rayon)}}{9072 \text{ (deniers per lb.)}}$$

At this point it may be well to note that although the report of Committee D-13 suggests a different formula for returning the original moisture content for the purpose of testing to

cellulose-acetate rayons (such as celanese) as compared with other rayon, no different method is mentioned for determining the counts or size. It seems reasonable to assume that the denier or yarn number of cellulose-acetate rayon is calculated in the same manner as nitro-cellulose, viscose, or cuprammonium rayons.

Useful Tables

Pending the acceptance of the proposed standard, those consumers the country over who are seeking some standard by which they may calculate counts, yards per pound, equivalents, etc., might well profit by the work that has already been done. For this purpose the following facts are submitted:

Of No. 1 rayon, 9,000 meters should weigh 1 gram; 900 meters, 0.1 gram; and 450 meters, .05 gram.

One meter equals 39.3696+ inches or 1.0936 yards.

One gram equals the weight of one cubic centimeter of water at maximum density.

1 grain = 1.296 deniers = .0648 grams = .036571 drams
1 denier = .7716 grains = .05 grams = ½ decigram = .0282187 drams
1 gram = 15.4322 grains = 20 deniers = .564374 drams
1 dram = 1/16 oz. = 27.3437 grains = 35.4375 deniers = 1.77211 grams
1 oz. = 437.5 grains = 567 deniers = 28.35 grams = 16 drams
1 lb. = 16 oz. = 7,000 grains = 9072 deniers = 453.6 grams = 256 drams

Owing to the impossibility of converting any measurements of the metric system into exact equivalent measurements in the English system, some of the above equivalents—especially those of long decimals—are not absolutely correct, nor can they be made so. And therein probably lies the seat of the whole difficulty. But the essential point is, not just what particular figures are decided upon as a standard, but that the figures be universally known and used, so that we may be as certain of them as we are that so much of this or that is a pound or a yard or a quart.

Equations Based on Tables

The following equations are based on the above facts:

The denier of a yarn is the weight in grams of 9000 meters; or the weight in grams of 9000 meters; or the weight in grams of a 225-meter skein × 40.

The yards per pound of any given denier equals:

$$\frac{4{,}464{,}528 \text{ (yds. per lb. No. 1 denier yarn)}}{\text{Given denier}}$$

Yarn number or denier equals:

$$\frac{\text{Wt. in grams of a 300-yard skein} \times 1.64}{0.05 \text{ (grams per denier)}}$$

Or, to eliminate one factor, and as multiplication is always easier than division:

Yarn number equals weight in grams a 300-yd. skein × 32.8.

When weighing in grains:

Yarn number equals:

$$\frac{\text{Wt. in grains of a 300-yd. skein} \times 1.64}{0.7716 \text{ (grains per denier)}}$$

Or, yarn number equals:

Weight in grains of a 300-yd. skein × 2.126

When measuring with the yarn reel that is common in most cotton mills (that with a perimeter of 1½ yards), the following equations may be handy:

To find count:

$$\frac{\text{Wt. in grains of 120 yards} \times 4.101}{0.7716 \text{ (grains per denier)}}$$

Or, simplified:

Weight in grains of 120 yds. × 5.135 equals yarn number or count.

To find the number of grains that 120 yards should weigh:

$$\frac{\text{Given count in deniers} \times 0.7716}{4.101}$$

Or, given count in deniers × .18815 (weight in grains of 120 yds. of No. 1)

To find the equivalent of any denier rapon in any other system:

Divide yards per pound of the given rayon count by the standard in which the equivalent is desired.

Example: What is the cotton equivalent of a 150 denier rayon?

Solution:

4,464,528 ÷ 150 = 29,763.52 yds. per lb. of 150 rayon.

29,763.52 ÷ 840 (cotton standard) = 35.43 or approx. 35/1 cotton.

To find the equivalent in the rayon system of any count of another system:

Divide 4,464,528 by the yards per pound of the given count.

Example: What is the rayon equivalent of a 36/2 cotton?

Solution:

36/2 = 18/1 18 × 840 = 15,120 yards per lb.

4,464,528 ÷ 15,120 = 295.27 or approximately 300/1 rayon.

To find tram silk equivalent of any denier silk:

$$\frac{4{,}464{,}528}{\text{given denier count} \times 16}$$

To find the rayon equivalent of any tram silk:

$$\frac{4{,}464{,}528}{\text{Tram silk count} \times 16}$$

To find the rayon equivalent of any dram silk:

Divide 4,464,528 by the yards per pound of the given dram silk. Or thus:

$$\frac{\text{Given dram silk No.} \times 4{,}464{,}528}{256{,}000 \text{ (yds. per lb. of No. 1 dram silk)}}$$

To find the dram-silk equivalent of any denier silk:

Divide 256,000 by the yards per pound of the given denier silk. Or thus:

$$\frac{\text{Given denier count} \times 256{,}000}{4{,}464{,}528}$$

COMPARATIVE YARN TABLE

Denier No.	Yards per Pound	Yards per Ounce	Weight in Grains 120 Yards	Spun Silk and Cotton Equivalent	Worsted Equivalent	Linen Equivalent	Meters per Kilogram
40	111,613.20	6.975,83	7.5	132.87	199.31	372.04	225,000
45	99,211.73	6,200.73	8.5	118.11	177.16	330.71	200,000
55	81,173.24	5,073.33	10.3	96.63	144.95	270.58	163,636
60	74,408.60	4,650.54	11.3	88.58	132.87	248.03	150,000
65	68,685.05	4,292.32	12.2	81.77	122.65	228.95	138,461
75	59,527.04	3,720.44	14.1	70.87	106.30	198.42	120,000
80	55,806.60	3,487.91	15.1	66.44	99.66	186.02	112,500
85	52,523.86	3,282.74	16.0	62.53	93.79	175.08	105,882
90	49,605.87	3,100.37	16.9	59.05	88.58	165.35	100,000
95	46,995.03	2,937.19	17.9	55.95	83.92	156.65	94,737
100	44,645.28	2,790.33	18.8	53.15	79.72	148.82	90,000
110	40,586.62	2,536.66	20.7	48.32	72.48	135.29	81,818
120	37,204.40	2,325.28	22.6	44.29	66.44	124.01	75,000
125	35,716.22	2,232.36	23.5	42.52	63.78	119.05	72,000
130	34,342.52	2,146.41	24.5	40.88	61.33	114.48	69,231
140	31,889.49	1,993.09	26.3	37.96	56.95	106.30	64,286
150	29,763.52	1,860.22	28.2	35.43	53.15	99.21	60,000
160	27,903.30	1,743.96	30.1	33.22	49.83	93.01	56,250
170	26,261.93	1,641.99	32.0	31.26	46.90	87.54	52,941
175	25,511.59	1,594.47	32.9	30.37	45.56	85.04	51,429
180	24,802.93	1,550.18	33.9	29.53	44.29	82.68	50,000
200	22,322.64	1,395.17	37.6	26.57	39.86	74.41	45,000
240	18,602.20	1,162.64	45.2	22.15	33.22	62.01	37,500
250	17,858.11	1,116.13	47.0	21.26	31.89	59.53	36,000
300	14,881.76	930.11	56.4	17.72	26.57	49.61	30,000
360	12,401.47	775.09	67.7	14.76	22.15	41.34	25,000
450	9,921.17	620.07	84.7	11.81	17.72	33.07	20,000
600	7,440.86	465.05	112.9	8.86	13.29	24.80	15,000
900	4,960.59	310.04	169.3	5.91	8.86	16.54	10,000

Note: The third column (yards per ounce) is also the Japan Tram, Tussah and Tsatlee Tram silk equivalent.

ELIMINATING FUZZ IN SILK WARPS

By H. E. Wenrich

A great deal of defective silk goods is the result of fuzzy warp threads. This fuzz can be created in preparing the warps for the loom or in the weaving itself. Fuzz resulting from the threads riding on the race plate is the cause for many pieces being sold "as is," due to the split ends causing broken warp threads and numerous small floats. The one- and two-pick floats especially can be traced directly to split ends which form small fuzz balls and hold down one or two warp threads. These small floats are generally known as pinhead floats and appear very sharply on the surface of the cloth after finishing. The fuzz balls that cause these pinhead floats are known as "snowballs," and also as "beads."

Many splitting ends which are traced to the race plate can be easily overcome if the race plate is really at fault. However, some of the warp stock which has been improperly treated in preparation for the loom will in itself create a great deal of fuzz. Sharp heddles and badly damaged reeds will also cause this defect, as will false reeds which have been improperly hung in place and not attached as they should be to the lay. Defective warp rods will cause fuzz and place a great deal of work on some fixers who pay scant attention to them. Improperly timed shedding will also give the fixer trouble, as will also a pair of poor shuttles.

Trouble in Winding

In preparing the silk for the warp, a great deal of care must be taken in the handling of the fiber before it goes to the winders and while it is being wound ready for the warping. Nearly every mill has a pet idea as to the manner in which the silk should be soaked for warps; but as this is a subject of considerable magnitude in itself, it will be necessary to discuss it separately at another time. Herein we shall consider the matter of fuzziness from the winders on.

At the winders we find an opportunity to prevent fuzz before the warps are made. It is of utmost importance that the porcelain guides on the winders be free from cuts and grooves. These cuts which appear in the guides are due to long wear over a period of months caused by the warp thread running constantly in the one place. After the guides have become cut by the warp thread, they should be removed as soon as noticed and replaced with new porcelain guides that are free from nicks.

It will be readily seen that in running one size of thread—say, 13/15—and afterward running a larger—say, 20/22—over the same guide, the groove or cut made by the smaller thread will

chafe the larger thread, thus splitting open the gum. Every thread cut in this manner will be difficult to run after it is once in the loom. Trouble is also experienced when a thread is run through a cut made by a larger thread. Suppose, for example, that a 13/15 thread is run over a guide which has been cut by a 20/22 thread. The cut in the guide will be larger, and every burr, slug, or knot which comes to the cut will be broken off at the edge as the thread enters.

Excessive weight on the swifts will also crack open the fibers and cause fuzz. All the swifts should have as uniform weight as possible on the same size of thread.

Precautions in Warping

During warping, the bobbins should not have excessive drag in the creel. The more drag or pull which the bobbin is given, the more the thread will be stretched. Also, the stretch will be greater on the finer threads, and these will be damaged more readily by cracking and peeling of the gum. All bobbins in a creel should be given an even pull, but this pull should not cause them to run on after the mill is slackened gently.

It is also important that the weights while beaming be sufficiently heavy to make a properly beamed warp, but the weighting must not be overdone. Many mill foremen instruct the warpers to pile up the weight on the levers so the yarn will be stretched to enable the mill to gain several yards. This is a very bad practice and is harmful to the material, reducing the elasticity which is needed in the weaving. A few yards gain here will be more than counteracted by poor cloth. At first appearance this practice might appear to save money for the company, but after summing up the results, one is bound to be convinced it is a very poor policy. Loss is sustained through less production and higher operating cost, as well as inferior merchandise.

Twisting-In Department

In the twisting-in department it is advisable to have all harness marked in some manner to show which is defective in heddles, frames, or reed. Of course it is out of the question to throw away harness that can be used for work later on, but it will prove advisable to junk any harness concerning the value of which there is the least bit of doubt. Harness that has become badly worn will certainly prove a big handicap toward making marketable merchandise.

In discovering defective heddles in made-up harness, providing an entire shaft is defective, the following procedure is useful: While the harness is in the loom, mounted with one shaft up at a time, press firmly downward on the ends in back of the harness with the forearm. If the heddles are sharp, the warp ends will snap out at the heddle eye. The eyes will show a

sharp edge or small groove if looked at through a pick glass. This indicates that the heddles are useless. Sharp heddles and cut heddles will cause the ends to split and form fuzz from the heddle forward to the reed, and also from the back of the heddle to near the warp rods, where the shed chops the split ends into a very fine fuzz which has the appearance of lint. Heddles used for hard-twist silk should never be used for raw stock, as such heddles are cut quickly.

Sharp reeds will also cause the ends to split, and will brush back the fuzz on the backward stroke of the lay, forming small beads and pinhead floats. The reed can be polished, first by using a stone on the wires, then by taking off the sharp edges with a piece of lead, and afterward by removing other particles left on by the lead by means of a piece of wood. After a reed is polished, the dents should be brushed out with a stiff brush to remove all the particles of stone that are left hanging between the wires.

One good method of determining whether the reed is at fault is to move several warp threads up and down through the dents. If the reed is causing the trouble, the ends will be so chafed as to be observable without the aid of a glass. It is advisable to find the cause of damaged reeds in order that further trouble will be eliminated. A sharp reed is often found to be caused by pins coming out of the back of the shuttle and cutting the wires. Improper picking of the type which drives the shuttle against the reed will also damage the wires.

False reeds that have become damaged and sticky with lint will cause fuzziness. These reeds, which serve to separate the warp threads and split up the dents of the front reeding, act as brushes to the separated ends on the lift of the shed and tend to break apart the fuzz, preventing the pinhead floats. In order to prevent formation of fuzz by the false reeds, care must of course be taken to see that the false-reed wires are free and do not bind. If they bind, the warp threads at these points will be forced apart, and splitting will be caused by both the false reed and the front reed. The warp threads binding will make a streak through the woven material.

Attention to the False Reed

In securing the false reed to the lay, the method illustrated in Fig. 1 can be used to advantage. This trick will save time in tying the bottom of the reed to the lay and will also allow a little movement to the false reed. The contrivance illustrated is made from a piece of wire and is secured to the back of the reed bed, low enough so the bottom part of the false-reed frame will not be so high as to come in contact with the warp threads. The wire is bent as shown, sharpened at the points, and driven into the reed bed. One of these holders is placed at each side of the bed. On top of the handrail two screw eyes are placed,

one on each side. The false-reed frame can be tied at the top to the screw eyes very handily. The screw eyes from worn-out dobby cords are very good for the purpose. If the false reed is allowed to bump against the harness, the heddles will rub the warp threads sharply and cause fuzziness.

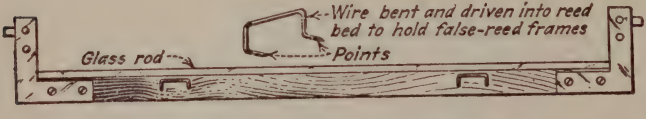


Fig. 1. Method for securing false reed to the lay

Trouble at the Warp Rods

When fuzz is noticed in back of the harness, between the heddles and the warp rods, it will often be found that the rods are doing the damage. The rods, if wood, will be found to be cut in small grooves in the direction the warp threads run. These grooves on the top and bottom portions of the rod will be the depth of several warp threads in some places, and it will be found that a number of these threads will be trying to crowd down into a groove. This will split the threads, breaking open the gum and causing fuzz in its worst form. The method for treating this defect is to remove the warp rods and sandpaper them down smooth, afterwards rubbing shellac into the grain of the wood.

The best prevention for fuzz caused by the warp rods is to use rods that will not cut, such as those made of glass or brass. Of the various rods that I have used to date I prefer the brass rods. Glass rods are also very good, but they will do a great deal of damage if they become broken in the loom while it is running. Rod breakage in the loom is very rare; but when it does happen, it ruins several yards of silk and makes it necessary to rebeam the warp.

In cases in which wooden warp rods are used and the warps are found to be very fuzzy in back of the harness for this or other reasons, a third warp rod will be found very handy for breaking up the fuzz and making the warp run better. On taffeta weaves, the regular lift must be split up and the third rod placed in this shed in front of the other rods. The fuzz will work back and collect at the third rod, instead of running into the heddles and causing the ends to break and float. This third rod can be of $\frac{3}{8}$-in. steel, smaller than the regular warp rods. The cost of this extra rod is but a few cents, but the rod will soon repay its cost by increased production alone, not counting the better piece of merchandise that will be woven.

Wrong timing of the harness will also cause fuzziness, depending upon what weave is being employed. In case the timing is early and the shuttle damaged, the ends of the warp will be badly chafed where the shuttle comes in contact with them. This contact occurs especially along the sides of the material, and often causes badly woven edges. Keeping the shuttles in first-class shape will go a long way toward reducing end breakage and fuzziness, but will not be sufficient if the shafts are not properly timed.

Race Plate an Important Factor

In searching for cause of fuzz in the warps, one of the most important things to consider, and often the most neglected, is the race plate. Every end rides the race plate at one time or another during the picking of the loom, and damage to ends at this place is a common occurrence if the proper precautions have not been taken before placing the warp in the loom. As will be easily understood, the constant beating of the lay causes the ends to cut small grooves in the plate, the entire width of the cloth. These grooves are more readily cut by weaves that call for the use of hard twist in the warps, such as georgette. It will also be understood that the tighter the warp is stretched and the heavier the weave, the sooner and deeper the cuts will be developed.

Grooves cut down into the wood surface of the race plate allow several warp ends to crowd down into each cut, causing undue friction, cutting open the gum, and splitting the threads. The threads which are broken open will be fuzzed up, and the rubbing during the forward and backward beating of the reed will form small beads in back of the reed. These beads collecting in larger amounts will tend to hold together threads in the same dent or adjacent dents and cause small pinhead floats.

The grooves in the race plate not only cause damage by forming fuzz balls, but also break ends containing knots, because such ends are kept in the grooves by other ends and the knots do not have a chance to weave in as they should. If the reed should be shifted slightly while in motion, the ends will be snapped out and given a clean cut at the edges of the grooves. The same will be true if the warp threads are moved by the hands of the weaver and forced out, of the natural beat-up of the lay.

Race-Plate Trouble Remedies

To overcome fuzz and cut ends which are caused by a damaged race plate, it is a wrong policy to smooth the race plate and then run the loom. This is but a temporary repair. In making the right fix to overcome this defect, the glass rod on the reed bed should be raised so the warp threads will be

lifted slightly off the race plate. As is often the case, some fixers will raise the sides of the glass rod and neglect the center. The center is often found to be bent down further than the sides. If the rod is bent downward or the reed bed has sagged in the center, a means of raising the faulty part must be found or no real repair can be made.

A small roller placed beneath the reed bed—between the reed bed and the part of the lay on which the reed bed rests—will give the necessary results. This roller can be made of a piece of picker rod cut 2 in. long and laid into a piece of curved steel sunk into the reed. Fig. 2 shows this fix and should make it clear that a swinging reed is not hindered by it. However, if the glass only is bent, a small amount of padding may overcome the trouble. This should be placed between the glass rod and its bed, and held in position by means of a small amount of glue. When the rod is lifted to hold the ends off the race plate, this fix will keep the ends from damaging it.

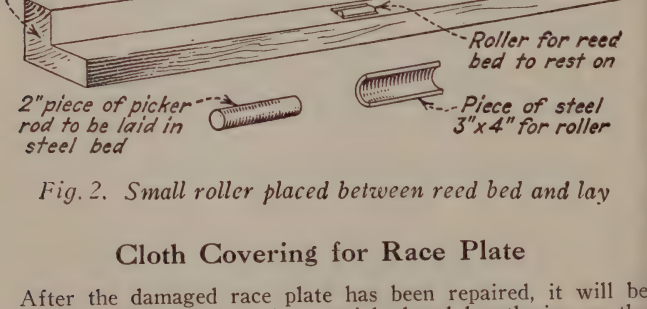

Well for center filling stop motion
Race plate
Lay
Roller for reed bed to rest on
2"piece of picker rod to be laid in steel bed
Piece of steel 3"x4" for roller

Fig. 2. Small roller placed between reed bed and lay

Cloth Covering for Race Plate

After the damaged race plate has been repaired, it will be found that a piece of cloth material placed lengthwise on the race plate will be beneficial to the weaving of perfect cloth. This cloth prevents the warp threads from touching the hard surface of the race plate and also serves as a cushion to the threads when the shuttles are thrown through the shed. This material can be corduroy, billiard cloth, felt, or woven cotton tape of the required width. The felt, billiard cloth, and tape are furnished in the widths desired by the factory-supply houses. The tape will be found cheap and long wearing; although billiard cloth is favored in many mills, due to its lasting qualities and softness. The better quality of billiard cloth is desirable, as it will outlast the cheap grades five to one.

Whatever material is used, it is glued to the race plate and

left to dry before the piece at the center or side filling motion is cut out. At each end of the lay, it is found advisable to cut a small groove in the race plate, into which the ends of the material covering the race plate may be glued. This prevents a sudden rise being presented to the shuttle, and keeps it from flying out.

When this cloth covering is applied to protect the ends, it will be necessary to raise the shuttle boxes above the level of the race plate. The boxes should be at all times slightly above the level of the race plate to prevent chipping on the top and also to prevent the shuttle hitting the warp threads too harshly. While the shed is rising on a box loom, the shuttles are about to change. As the shed changes and before the threads going downward have come to a complete rest on the race plate, the shuttle is driven out of the box. The same thing happens as the shuttle is leaving the shed. As the lay is coming front center, the warp threads are raised off the race plate as the shuttle passes out of the shed to enter the box. This action forces the shuttle up and keeps it in this position, riding the warp threads. This requires only a fraction of a second and is too fast for the eyes to follow.

On wide looms which are weaving narrow fabrics, the shuttles will come down onto the race plate again after leaving the shed and before entering the boxes, causing the shuttle at times to fly sideways into the box. It will be found necessary on wide looms weaving narrow cloth to keep the boxes lower (but still above the race plate) than on looms weaving material that comes within a few inches of the end of the reed or takes up the entire reed space.

Conclusions

To weave material that has a tendency to be fuzzy, therefore, it is first necessary to find the fault and to attempt to overcome it. If the fuzz cannot be overcome, the weavers should be instructed to keep the yarn behind the reed free from beads as much as possible. The weavers can draw the beads through the reed dents before any serious damage is done. Although this will slacken up production, it will be the means of producing a better material; and, after all is said and done, this is the only right way to weave silk.

HOW LOOMFIXER CAN ELIMINATE CENTER FILLING LOOPS

By H. E. Wenrich

A serious defect that has proved troublesome to both experienced and inexperienced fixers is the looping of the filling at the center of the fabric. Although this defect is at times

very hard to detect in some classes of material while the loom is in operation, it can easily be found by the inspection room after the mischief has been done. These loops are made by the filling feeler wires holding the filling down while the lay is beating in the pick.

These loops will be the cause of a second, regardless of whether they are large or small. They must be clipped off by the pickers; and, when the piece is finished, a small hole will be caused—especially in crepes, due to the take-up of the filling. How bad a piece will be the result of center loops depends on their number. If occurring on every few picks, the piece will be entirely ruined—but center loops running steadily should be detected at the loom.

Possible Causes

There are a number of possible causes to look for in attempting to eliminate the trouble. The loops are often due to defective picking and to a wrong check on the shuttle. Both too early and too late checking of the shuttle may be found to account for the defect at various times. If the pick is early, the shuttle will strike the feeler wires and cause a snap-back of the fork, which will drop quickly on the filling instead of gently; the center loops being caused by this snap to the fork. To overcome these loom troubles, attention should be given to the parts affected.

A late, as well as a too early, shed will cause counter loops at times, but I find this to be a very rare occasion and that the trouble is usually at some other point.

Other causes for center loops include loose shuttle tension; too tight a tension on the stop-motion spring; touching of the shuttle by the feeler wires, due to their being too low; high bend of the filling-motion dagger; a nick on the bottom of the frog; and shallowness of the feeler well. When the spring on the filling motion is broken, the result will often be long center loops; in which case a new spring can be applied or the old one repaired, if still serviceable, by the bending of a new loop. Still other defects and remedies are listed below.

Loose shuttle tension. If the rubber is broken apply new rubber. Perhaps the rubber is too loose or too tight. Many inexperienced fixers tighten the rubber which holds the tension ring so much that the filling slides freely through the rings just as though the rubber were broken. In testing for the right tension on the tension ring, draw the thread out slowly: there should be a slight pull which will move the ring clear up and back as the filling is released. This pull should vary according to the size of the thread, as quite naturally a two-thread must move more freely than a six-thread. The tension should be adjusted according to the size of the thread

ınd the class of material being woven. Loose shuttle ten-ıion can also be traced to worn-down fur in the sides of the ;huttle. In this case new fur should be placed in the shuttle. Fine filling requires more closely clipped fur than the heavier hreads.

Some fixers tighten the spring to prevent broken picks. This remedy for broken picks is often unsuitable, because he resulting center loops are often worse defects than the ›roken picks. The spring should be kept as loose as possible vithout its proper functioning being prevented. Here again he size of the thread must govern the tension that one should ›lace upon the spring, as too tight a spring in the filling notion will sometimes cut fine filling threads.

Dagger bent high. Often a fixer will resort to tricks in ›rder to make a temporary repair which will serve to finish veaving a piece up to the cut mark. This, in some cases, will be satisfactory; but after the cut mark is reached, a ›ermanent repair should be made. One of these tricks con-ists of bending the dagger up to hit the frog and knock off he loom. This repair is very unsatisfactory, and should be emedied as soon as possible—if made at all. If the dagger s too high, it will nip on the bottom of the frog and often ·ause center loops. The filling stop motion should be re-›aired, so the dagger will be straight at all times.

Defective frog. Some of the castings will have small nicks ›n the bottom which will be struck by the dagger point, thus ausing center loops. It is obvious that the remedy here will ›e to grind down the bottom side of the frog. The frog or 'cam bunter," as it is known by many fixers, is provided with groove where the dagger strikes it. This groove should not ›e so deep that it will cause the dagger to stick in it after :nocking off the loom, and thus become broken. The groove hould have a round edge on the bottom so that the dagger ›oint, after hitting the groove and knocking off the loom, will lide off the frog.

Small well. The well affords an opportunity for applying ne of the best remedies for center loops. It should be deep nough for the feeler wires to have a good leverage while in peration. Often a new loom needs attention in regard to this natter. The fork is located in the well, generally in the enter of the lay, and swings up directly toward the reed. \s the lay moves toward back center, the feeler wires tilt pward to allow the passage of the shuttle underneath; and, s the shuttle passes under, the filling is laid directly under he feeler wires. As the lay comes front center on the beat-up, he fork or feeler wires drop downward onto the filling, vhich holds it up to prevent the loom knocking off. If the lling is broken or the shuttle is empty, the fork drops down ı the well and knocks off the loom. Now suppose the filling s under the fork while the loom is in action. If the dagger

touches the bottom of the frog as the lay comes front center, it will often hold the fork in position to cause a drag on the filling, and will thereby cause small center loops. This same effect will result, of course, from the spring being tight.

Timing the Stop Motion

In Fig. 1 is shown the general features of the stop motion on a well-known silk loom. Notice that this type of motion is in the center with both feeler wires and the knock-off dagger. Some of the later-type looms and rebuilt looms have the feeler motion in the center and the knock-off motion on

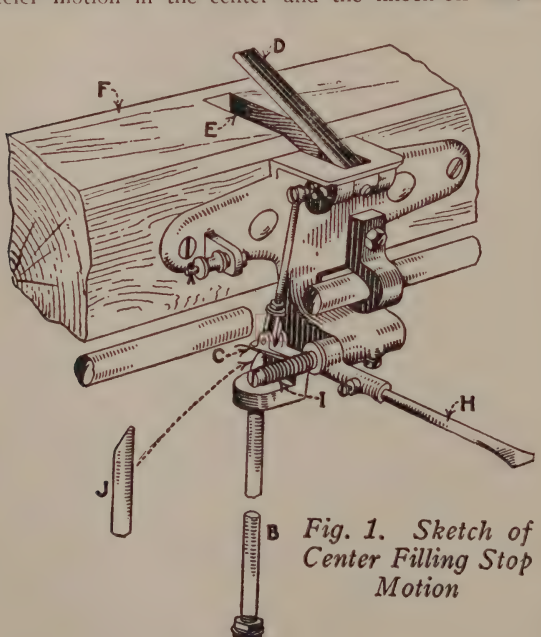


Fig. 1. Sketch of Center Filling Stop Motion

the side. Both work on the same principles as far as the de fects mentioned in this article are concerned.

The casting *A* is secured to the bottom of the loom, and i provided with an adjustable slot which permits timing o

the motion. As the lay is beating backwards, the rod *B* is placed into action, and lever *C* is pressed on to the end of it. This action forces the feeler wires *D* up out of the well *E* on the lay *F*. At the same time, dagger *H* is forced downward. As the lay comes front center, the spring *I* pulls dagger *H* up, reversing the process just mentioned. If the filling is not under the fork, the dagger strikes the frog. By moving the rod *B* forward in the slot in the casting *A*, an

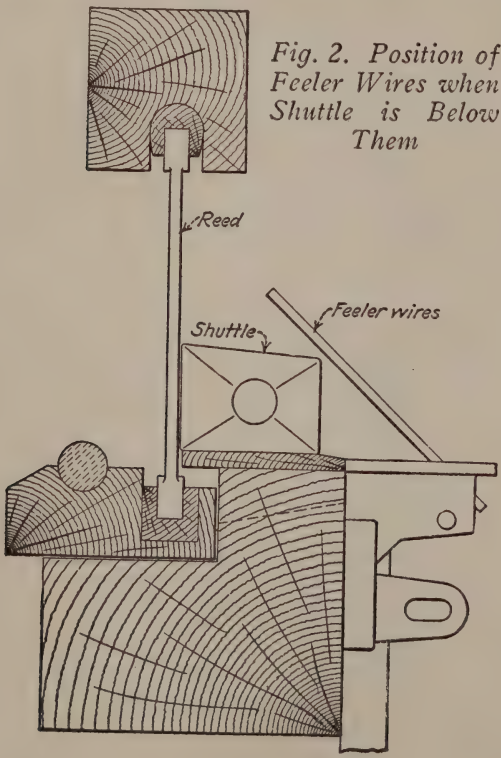


Fig. 2. Position of Feeler Wires when Shuttle is Below Them

early motion is given. However, this rod must not be too close or forward, as it will rub the sand roll and cut the cloth, thereby causing more damage.

Fig. 2 shows the position of the feeler wires when the shuttle is resting on the lay beneath them. The wires should

be at least $\frac{1}{8}$ to $\frac{1}{4}$ in. above the side of the shuttle when the lay is all the way back center. However, before adjusting this part we must adjust and time the dagger and fork as shown by Figs. 3 and 4. The well in the lay must be deep enough so the dgager will be in a position to knock off, as shown in Fig. 3, when the feeler wires are resting in the bottom of the well as shown by dotted lines. Also the dagger must clear the frog, as shown in Fig. 4, when the feeler wires are $\frac{1}{16}$ in. below the edge of the well at the *front of the wires* towards the reed. The dagger should clear at least $\frac{1}{8}$ in.

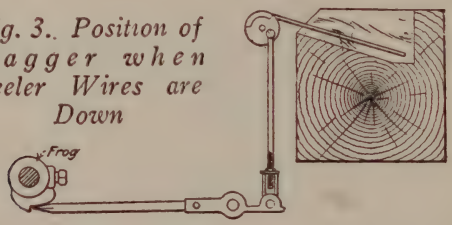


Fig. 3. Position of Dagger when Feeler Wires are Down

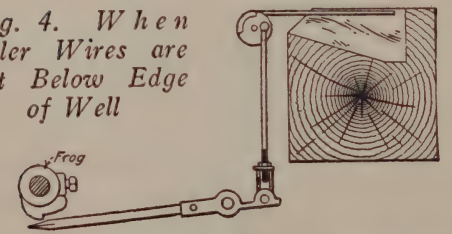


Fig. 4. When Feeler Wires are Just Below Edge of Well

below the frog, and not touch it, as is the case when some fixers repair this part. The only manner in which this can be accomplished at times is by cutting the well deeper.

After the fork has been timed as described, the lift rod *B* should be so timed that the shuttle will clear the feeler wires as in Fig. 2. I have found that this can be done in an easy and excellent manner by grinding the point of the lifting rod as at *J* in Fig. 1. This gives an angle to the rod so that when the rod is forward, it is given a good clearance, which gives a better leverage as the lay moves back center.

Timing the filling stop motion as above can be easily accomplished and is better done than by trying to time it by cams, as is done in some mills. I will say from experience that by this method a loom can be made to run for a long period of time without making cloth containing center filling loops, due to any incorrect timing of the center filling motion.

In crepes and taffetas the loops are not as likely to be caused as in satins, for generally in satins the spring is tightened slightly more on account of the heavy filling under the pick. If the parts are not working properly, the filling loops will cause a very bad piece, as pickers many times pull the loops in picking and shift the satin. Pickers should be instructed to pick clean and to call the attention of the person in charge immediately to the slightest sign of loops. The defect can thus be overcome before causing too much damage.

Cloth inspectors should be instructed while inspecting the material on the looms to look on the bottom take-up roll for this defect, as it is often the case that the defect can be discovered on the bottom roll quite readily.

Fixers should be on the watch for this defect and should give any loom causing center loops a thorough going over after the warp is woven out, regardless of what caused the loops while the loom was in operation.

PRACTICAL METHOD FOR SILK-WARP CALCULATIONS

By R. H. Cannon

The following method of planning or figuring a silk warp from the amount of stock on hand is very helpful when small lots and dyed lots of yarn are being used. The type of warping machine is the horizontal, with or without Swiss motion. In using this method, it is necessary to know the number of bobbins in the particular lot of yarn, the total number of threads in the warp, and the width of the material.

First Step. Divide the total warp threads by the number of bobbins, and the answer is the possible numbers of sections. Should there be a remainder, increase the number of sections by one; then divide the increased number of sections into the total warp threads. If this shows an uneven number of threads for each section, it will be necessary to decrease them by one, as the number of threads in eac hsection must be divisible by two without a remainder. Otherwise the leases in each section must be reversed alternately. When the number of threads per section and the number of sections have been determined they must be multipled together in order to find out if they equal the total warp threads. At this point the remainder is divided by two, because a single lease reed is used and two is the least number of threads that will make a perfect single lease. The answer is the number of sections of which each must have two more threads.

Second Step. The warp is usually made two or more inches wider than the material to allow for contraction in weaving. To find the width of one section, divide the number of sections into the increased width of the warp. If section pins are used, the remainder must be changed to the fractions marked on the warping reel—usually fourths, eighths, or sixteenths. Now multiply the width of a section by the number of sections to see if the warp is wide enough.

Third Step. The next thing to consider is the sleying of the section reed. Multiply the width of one section by the number of dents the section reed has to the inch. Then divide the number of dents for one section into the threads per section. This will give the number of threads per dent. The remainder is reduced approximately to get what percentage of dents should have more threads. The idea is to get the spread of the threads on the warping reel as even as possible.

Application of Method

Example:
Total warp threads, 7,832.
Width of material, 27 in.
Number of bobbins, 400.
Single lease reed.
Section reed, 60 dents per inch.

First Step.
7832 ÷ 400 = 19 possible number of sections.
19 + 1 = 20 sections.
7832 ÷ 20 = 391 threads, which cannot be divided by two evenly. Therefore 391 — 1 = 390 threads.
390 threads per section × 20 sections = 7,800, number of warp threads if 390 threads are used in each section.
7832 total warp threads — 7800 = 32 threads needed to give the exact number of warp threads.
32 ÷ 2 = 16 sections which must have two more threads, or 392 threads.
20 total number of sections — 16 = 4 sections which will have 390 threads.

Proof: 16 × 392 = 6272
4 × 390 = 1560
20 sec. 7832 warp threads

Second Step.
27 in. width of material.
27 + 2 = 29 in. increased width.
29 ÷ 20 sections = 1 9/20 in., width of one section.
Changing 9/20 in. to sixteenths = $\frac{7}{16}$ in.
Therefore $1\frac{7}{16}$ in. would be the width of one section.
20 x $1\frac{7}{16}$ = $28\frac{3}{4}$ in., width of warp. This, however, is not two inches wider than the material. Therefore each section must be $\frac{1}{16}$ in. wider, or $1\frac{1}{2}$ in. wide. Then, 20 x $1\frac{1}{2}$ in. = 30 in. which will be used for the width of the warp.

Third Step.
Section reed has 60 dents per inch.
Width of each section, $1\frac{1}{2}$ in.
Threads per section, 392.
60 dents per inch x $1\frac{1}{2}$ in. = 90 dents to a section.
392 ÷ 90 = $4\frac{2}{9}$ threads per dent (approximately).

One third of the 90 dents must have five threads. This is the way they will be sleyed: Two dents of four threads, one dent of five, two dents of four, one dent of five, and so on. The spread of the warp threads must be uniform; therefore the dents having five threads cannot be sleyed together in any part of the section, but must be distributed among the dents having four threads in some regular way. By reducing the remainder, approximately the percentage of dents which should have more threads is obtained.

REMOVING COTTON FROM SILK IN MIXED FABRIC

Technical Editor:

I would like to know how I can remove cotton that has been woven into cloth with silk, without injuring the silk. (6735)

The removal of cotton that has been woven into cloth with silk can be accomplished by resorting to the regular carbonizing process with sulphuric acid. This process is used in the removal of cotton and vegetable matter from wool. Briefly, it consists, of immersing the fabric in a solution of sulphuric acid of from 4° (3%) to 8° (6%) Tw., and then passing through squeeze rolls to squeeze out the acid evenly, or running in a hydro-extractor. The goods are then dried in suitable drying apparatus or a carbonizing oven at a temperature of from 125 to 140° F. The temperature can then be increased to around 212° F. to complete carbonization of the cotton or vegetable matter. The goods may then be put through a beater for removing the charred vegetable matter, and the remaining silk thoroughly washed to remove all traces of acid. The material is finally given a slight neutralization with a small amount of ammonia or soda ash, very dilute.

It would undoubtedly be best to make some experimental tests with this process before trying it out on commercial size lots, in order to determine the proper strength of acid to use and the temperature of drying, so as to arrive at the conditions that will have the least effect on the silk fiber.

STARTING MARKS . . .

The Bugbear of Silk and Other Weave Rooms

By H. E. Wenrich

Mention starting marks to the weaving foreman and see how quickly he hustles to the loom that is causing the defect. The loom is gone over from weights to dobby jacks, but the investigation often leaves him in the dark as much as before. The starting marks can be remedied at once if they are due to loom breakage or to some part coming loose; but when the basis of the trouble is not so evident, it requires the better part of a day's work for the section foreman and fixer to find it.

There are so many causes for starting marks that it requires considerable space to explain them and to define the various terms used in speaking of them. A real starting mark is entirely different from a joining mark, although heavy and light joining marks are referred to as starting marks in many mills.

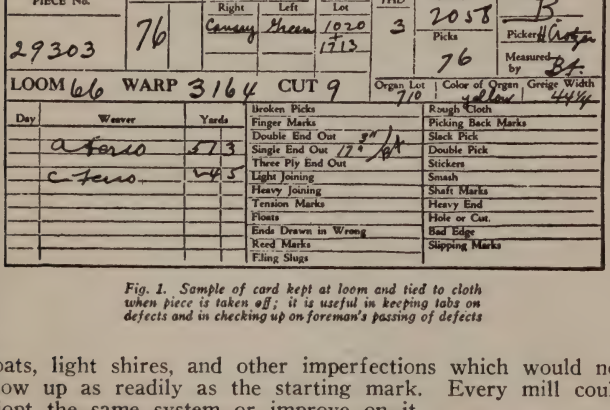
The mere mention of starting marks is often sufficient to create a heated discussion, because many different ideas are held regarding their causes and remedies. The first step in finding the cause is to determine the type of the starting work in order that one may be governed accordingly. There are several means of sifting the trouble and bringing it down to a few, certain well-defined causes. Once the cause is definitely determined, the recurrence of the same defect may be prevented.

Common Starting and Joining Marks

A common starting mark is that caused by the starting up of the loom after it has remained idle for several days. We have also joining marks (called starting marks) after the weaver has ripped out some defect and started up the loom again. These joining marks, when tight about two to ten picks or more—as is usually the case,—are caused by improper setting of the cloth against the reed. The weavers also will set the cloth light and cause light joining marks with a few picks less than the amount required to make a perfect join. On the cheaper class of merchandise, the starting marks are overlooked to a certain extent, especially if there is a big demand for the goods; but in the better class of merchandise, it is very nearly suicide to try to push material onto the market when there are starting marks through the piece. As most starting marks are caused after a rip back, it is here that the closest attention should be given.

One of the best methods to prevent starting marks is of course to eliminate the necessity for ripping out of other

defects that are of less importance. A worth-while practice, which one mill of my acquaintance insists upon and which I have adopted to a certain extent, is the inspection of all minor defects by the weaving foreman before the weaver is allowed to rip out the defect or to let it pass down. This has proved of great help in preventing starting marks due to ripping out. The weaver calls the foreman to inspect the float, shire, broken pick, or whatever the defect is, and the foreman places his "O. K." on any defect that could be passed. A broken pick close to the edge of the cloth is far preferable to a heavy or light joining mark. The same applies to edge


WEAVER'S CARD

Time Started 7/6 7pm Time Finished 7/8 7.83 night

PIECE No. 29303 | Yards 76 | COLOR OF TRAM Right Cream Left Cream | Tram Lot 1020 1713 | THD 3 | Quality 2058 | Class B | Picks 76 | Picker | Measured by

LOOM 66 WARP 3164 CUT 9 | Organ Lot 710 | Color of Organ yellow | Greige Width 44½

Day	Weaver	Yards
	a Ferro	51 3
	c Ferro	54 3

Broken Picks	Rough Cloth
Finger Marks	Picking Back Marks
Double End Out 3"	Slack Pick
Single End Out 17"	Double Pick
Three Ply End Out	Stickers
Light Joining	Smash
Heavy Joining	Shaft Marks
Tension Marks	Heavy End
Floats	Hole or Cut.
Ends Drawn in Wrong	Bad Edge
Reed Marks	Slipping Marks
Fling Slugs	

Fig. 1. Sample of card kept at loom and tied to cloth when piece is taken off; it is useful in keeping tabs on defects and in checking up on foreman's passing of defects

floats, light shires, and other imperfections which would not show up as readily as the starting mark. Every mill could adopt the same system or improve on it.

A small card kept at the loom and placed on each piece is very useful in keeping tabs on defects, and it affords a means of checking up on the foreman's passing of defects. A sample of this card is shown in Fig. 1. It is tied to the cloth at the time the piece is taken off the loom. After the piece has been inspected, the card can be sent back to the weaver, and it will show him the classification of the piece and the yards or picks woven, as well as any other facts that the inspector desires to inform him about.

However, when a heavy join or a light join has been made, the difficulty can be overcome with careful setting of the loom by an experienced weaver. There are numerous reasons for the heavy and light joins. One of the most common is of course inexperience of the weaver in setting the loom properly. A careful set will eliminate the mark in most cases.

One good way to set a loom is to let the cloth back several picks tight, make one pick, and then make another set. This often results in a proper beat-in of the pick and eliminates a bad set.

One of the reasons for a light join is that the weaver in setting the loom will let the cloth back the proper distance, lift the weights in place, make the set, and imagine all is well. He starts the loom up, and nine times out of ten makes a light join, due to the fact that, when the first pick has been made, the shafts shift into the proper place and cause a different tension on the warp. In letting the warp back after ripping out, the harnesses move backward and are held in this manner by the lifting of the weights. When the loom is started up once more, the shafts shift forward and cause a light joining mark of several picks. One good way to overcome the light join made in this manner is to use a cloth setter and reset the cloth for at least four picks. This will eliminate both light and heavy joining marks.

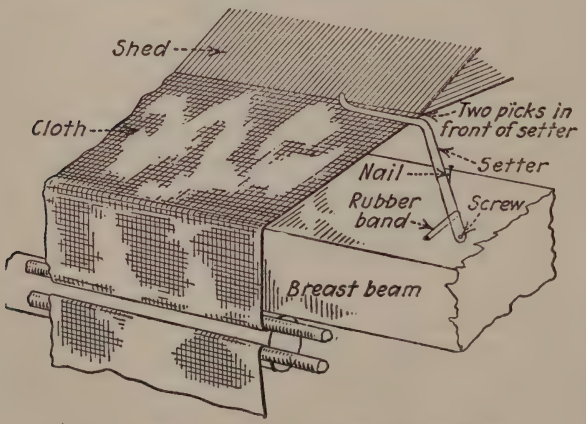


Fig. 2. Homemade setter for eliminating joining marks

A very good cloth setter can be made from the heavy steel ribbon taken from the shafts of a wire-heddle frame. A diagram, Fig. 2, showing this setter will give a clearer idea as to how to secure it to the breast beam of the loom. It should be taken into consideration that after the loom sets for a considerable period, the setter is not correct. To secure the proper results with this setter, the following procedure should be followed: After starting up the loom in the morn-

ing, run the loom for about ten minutes and see if the setter is adjusted correctly. If not, stop the loom with the one shuttle in the plain side, the lay back center. Now take hold of the pick wheel and let it back a half revolution, or at least twenty picks if possible. Bring the pick wheel back to the exact position it had been in. Bring the setter up against the nail as shown, and adjust so that two picks will show in front of the setter. For the balance of the day, two picks should be given after every set. In order that positive results may be obtained from this handmade setter or from any manufactured setter, it should be adjusted faithfully every day, and should be adjusted also for every new warp that is placed into the loom after it has been woven for five yards.

Notice that the setter is bent up in the front at the point. This is done in order that, if the setter has been left on the front of the cloth and the reed should accidently strike it, no damage to the reed will be done. A small rubber band as shown in the diagram on next page tends to bring the setter back and prevent its striking against the reed.

In setting the loom after ripping out a defect, the weavers often let the cloth back farther than is necessary and thereby cause a very bad set mark. In letting the cloth back in this manner, the sides are often forced to a greater extent under the pressure roll on the front of the loom than is the center of the cloth, with the result that, when the cloth has been stretched tight by lifting the weights, an uneven appearance and a set mark hard to overcome are found. The same bad join will also be caused in like manner if the cloth is on one half of the loom tight and on the other half loose. When the cloth has this appearance, it is advisable to release the thumb-screws on the pressure roll and loosen the cloth so it will slide back as evenly as possible; in this manner a better set can be made.

Use of Water

However, at times the only possible manner in which to make a set which is anywhere near perfection is to use water on the woven part of the cloth. By using water I have made sets that were considered impossible because of an uneven join of the cloth. The more surface on the cloth covered with the water, the farther back the woven cloth will stretch. This fact can be more readily understood than how to apply the water in order to set the cloth properly.

When making a set with the uneven join, bring the reed up against the cloth so it is front center and set the cloth in the best manner possible, without having any part of the cloth tight against the reed. The part of the cloth that is farthest from the reed should be dampened with water. Put the water on all places where it is desired to force the cloth nearer to the reed. As the silk becomes wet from the water,

it will stretch to the desired position, and an excellent join will be the result. Water should never be placed on the woven material unless it is uneven as described above.

Another method for eliminating set marks is by using water on the part of the shed out of which the woven picks have been taken. Supposing a weaver rips out two inches, makes a perfect set, and starts up the loom. After the loom has woven the picks back into the place from which they have been removed, a loose mark will be left at the place where weaving ceased before the rip-out. This is due to the picks falling back into the respective creases which they formerly made.

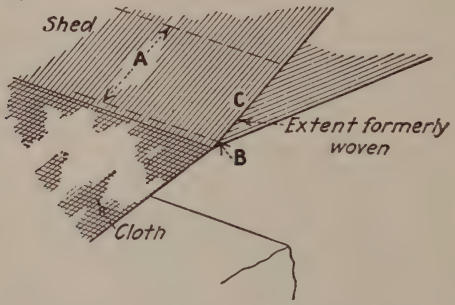


Fig. 3. After weaving back to B, dampen area A, or cloth will have a loose mark at C

This loose mark can be overcome as shown in Fig. 3. After the rip-out, the loom is set and allowed to weave part of the distance to extremity of the rip-out. After this the loom is stopped and a damp cloth is wiped on the unwoven part of the rip-out and past the extremity. The loom is then run for one pick and the same procedure is gone through with once more. After this the loom can be started up and will not leave any light join. Tight starting marks ripped out and damped in this manner will also be woven more perfectly and little trace of them will be left—in fact the tight mark will often be entirely eliminated by this method.

Some mills use soaking oil for the above remedy in place of water. Kerosene and benzine are also used and have proved satisfactory. The best thing that has ever come to my attention, however, was disclosed to me by a Frenchman who had used it for years with very good results. He took a teaspoonful of boric acid and dissolved it thoroughly in a pint of water, applying it in the manner I have described for water.

Rainbows and Broken Picks

If a weaver has trouble with a wavy appearance in the cloth, often known as "rainbows," after setting and starting up the loom, it is best for him to set the loom and run several picks, say about four, after which he should dampen the unwoven portion with the solution of borax and water. After this procedure no traces of the wavy set will appear. It should be thoroughly understood that no water should touch the woven part of the material and that the rag used in dampening the silk must be wrung out as nearly dry as is possible with the hands. The silk after being damped with the solution should be left to dry if it is to be a satisfactory set. After a weaver has been instructed in the use of this method he will surprise himself with the improvement he will be able to make.

Broken picks can be likewise treated so that not a trace of them will show. As is known, broken picks are a very serious problem today in many mills, especially those weaving material having a hard-twist filling from four-thread up. The heavier the thread, the more noticeable is the crack left by the broken pick. Only by the use of water or by brushing the tight pick back into place can the defect be covered up. Brushing the pick in with the pick-back is a very poor remedy and should not be adopted if the trouble can be overcome in any other way. One method adopted in such cases is to set the loom so that from two to four picks will be forced in tight. Some set the pick wheel back four picks or more before attempting to bang the broken pick out even, and still cannot overcome this defect.

In taking the crack out after a broken pick, remove the broken pick and find the correct pick for starting up the loom. Now use the damp rag and brush downwards from the fell of the shed to the woven pick, up and against the tight pick. It will only be necessary to dampen the part of the broken pick that has not been woven up, as this is the part that generally leaves traces of a crack or shire. After once becoming used to the manner of taking out defects with the water and borax, it will be a simple matter to make perfect set marks.

It is very important that in experimenting with joining marks all these experiments be made at the start or the finish of a cut as many defects will be caused by fixers trying to find a remedy in the center of a cut or other places in the cut before it has been marked off. At times it might be necessary to change a rope or the weights, or to change the warp to a different position. In such cases the loom should be left to run until the cut mark is woven up, unless the change is absolutely required. Changing a warp to a new position will give an uneven tension to the entire width of the warp; while

in changing a rope of weights, the one side of the warp will be shifted.

Looms that have the pressure roll in an exposed position will also be found to leave starting marks every time the weaver leans against the roller. Weavers running such looms should be cautioned against such a practice. As the weaver leans on the roller, a tight mark will be left; and as he moves away from the roller, a light mark will result. I recall once fixing a section of this type of loom when a weaver would continually recall me after I had left him. It took several hours to find the real cause of the trouble, and this was only accomplished by my moving on to other looms and watching the loom in question from across the aisle.

Speaking of the rollers, the take-up roll and sand roll should work in unison with each other correctly in order to bring out perfect pieces; but once the friction on the roller ceases to function properly, starting marks will be the result.

In the case of a loom which leaves a starting mark after it has been idle for an hour or so, the cause of the trouble will sometimes be found in the take-up friction. The friction disc on the drum shaft has a small pin to secure it to that shaft. After a loom has been running for a number of years, it will be found necessary to renew this small pin, which can be made from almost any material found in a fixer's supply kit. The old pin will be found worn to powder by its long service, and a renewal will help eliminate starting marks.

The leather disc in the friction disc should be replaced if the old one is worn thin. At times oil seeping into this part will cause undesirable slippage; and after the parts have been properly cleaned, a small amount of stove polish rubbed over the disc will let it slip and still retain the gripping tension that is required.

Another important part on the friction is the handwheel and the notched flange on a well-known make of loom. If this handwheel is too tight, it will at times cause a jerky motion of the take-up, forcing the take-up roll to pull the cloth entirely too tight in winding it up and thereby causing shirey cloth, which is also classified as "barré" by some mill men. If the handwheel is too loose, the least slippage on the sand roll will cause starting marks which are very puzzling to fixers who do not thoroughly understand the correct functioning of the take-up friction.

The fixer who understands this part can often tell by the feel of the cloth between the pressure roll and the take-up roller whether the friction has the correct tension. I would suggest that all fixers who do not understand this part make a practice of feeling the cloth as mentioned when working on a loom and so become accustomed to the feel. If the material is stretched too tight, the friction needs to be loosened by the handwheel; if it is too loose, the friction should be tightened

up. Never force the handwheel, as the knobs are easily broken off with undue pressure. The notched flange that fits between the friction disk and the handwheel should be kept free from waste, as also should the pin and button. If the button is forced out by some tool, it will be broken off; therefore care should be used in working on this part.

Heavy Material

Heavy material that needs a great deal of weight plays an important part with the friction take-up. If the friction disk does not have the proper tension, the notches on the notched flange will be broken off, and the flange must be replaced with a new part. Stripping of the take-up gears can also be traced to improper friction, as tight friction pulling unduly on the cloth causes the gears to strip. Lightly constructed looms running heavy jobs, such as radium, will often be found breaking down with stripped gears if the friction is functioning improperly.

A loom making starting marks without any apparent reason can be fixed by careful observation of the weights, their attachment to the loom, and so forth. A loom will be found to leave starting marks if it remains idle over night, due to a change in atmospheric conditions. Pulling the pick wheel up a few picks accordingly will eliminate this trouble. On a loom that requires the pick wheel pulled up four picks or any other amount, it will be found that the same amount pulled up the next morning will answer the purpose.

It is up to the careful observations of the section fixer as to what is making the starting marks, and his suggestions should first be tried out before discarding them. A little study on his part and putting his shoulders to the task will eliminate more starting marks than most experiments can do. A few instructions to the weavers and seeing that these instructions are carried out will prevent many tight marks that otherwise would cause imperfect merchandise.

THREE FAULTS IN THROWN SILK FOR FULL-FASHIONED KNITTING

Technical Editor:

We are manufacturers of thrown silk, which we supply to the full-fashioned knitting trade. The three criticisms we have most often put to us on our product are the following:

1. *Silk degums or strips in the carrier tubes.*
2. *Silk fabric sticks to the needles.*
3. *Knitted fabric is too stiff or starchy.*

Will you suggest overcoming each one of these complaints at the source, namely in our silk-throwing plant? Also tell us how the knitter can properly knit silk having any two or all of the three defects noted above? (7160)

Your silk degumming or stripping in the carrier tubes is probably nothing more than the trouble commonly referred to as "split ends." These are caused in the throwing in various ways. For example, when throwing a seven-thread, one end in the doubling may become broken or split, pass through the cleaner on the coning machines, and to the cone. Once this end passes to the cone and the cone is shipped out to the customer, it is bound to appear in the stocking.

It would be well for the throwster who is experiencing this kind of trouble to take several cones and reel them, say, 2,000 yd. on a reel in the form of a large diamond or what is known as an open-cross diamond. He would then have his own defect before him, and it would give him an idea as to what his customers are getting. He could trace it back to discover whence it came. It would be well for him to number his cones according to the spindles on the coning machine from which they are taken. By so doing he can go back to the coning machine and examine the parts for any defects, such as cutting. He should watch the washboards on the cones very carefully in order to discover when they are cut. It is also well when replacing with new washboards to mark the dates on them, in order to see how much service is being obtained from them.

If running hosiery tram on the 5-B spinners, one must see that the travelers are changed regularly and that the bobbins on the 5-B spinners are smooth and without nicks in the heads, as these will cause split ends. Care must also be taken to have the proper cleaners on the cones and to see that they are set properly. If they are set too wide, they will let waste pass through, and when this passes through the carrier it will strip back and give the same appearance as split ends. It is best to clean a four-thread on a No. 5; and a six-thread on a No. 7—always cleaning one number above the thread being coned. Some mills are setting their cleaning to break out all knots and are having the ends retied and the knots placed on the end of the cones. These knots can be greatly eliminated by tying the single thread in the doubling.

Now let us consider your difficulties with fabric sticking to the needles and being stiff or starchy. The silk knitter needs a soft, uniform hosiery tram that rapidly absorbs water or an emulsion. The knots must be as small as possible, and it is customary to tie a flat or weaver's knot so that it will pass through the knitting needles. If the silk is not soaked properly, it will stick to the needles and the knitted fiber will be too stiff and starchy. The proper formula for soaking is essential, if your thread is to be well lubricated and your knitted fabric soft.

Even with the proper formula, care and time must be taken in soaking, preparing the bath, and placing the silk in the tubs, or the silk will not take up evenly.

The method of taking a bundle of hosiery tram and pushing it into the tub containing the soaking solution will cause a very uneven absorption for the reason that the emulsion is constantly breaking up to a certain extent. In other words, the oil is separating out of the solution and going back to its original state, even though it stands but a minute. The top of the tub contains a greater percentage of oil than the bottom; and the first of the silk that is immersed absorbs the extra oil, thereby getting more than any other parts of the bale.

The proper method is to prepare the solution in a separate tub, keeping it constantly agitated by hand or power. Pour in—or, better, spray it—one layer of solution and then lay in one layer of silk. Follow with another layer of solution and another of silk, laying the second layer across. Continue until the whole bale is soaked. Care should be taken not to whizz the silk more than five to six minutes, as this will take out the oil and is likely to make the silk hard. Care must be taken to have the silk dry before winding.

PREPARING SILK FOR THROWING

Technical Editor:

Please advise me as to the best method for preparing silk for the throwing department. I soak the silk over night; after extracting I hang it on the winding machines to air dry. It contains about 15% moisture when placed on the swifts. I have been advised that after extracting and before winding it is preferable to open the skeins and hang them on poles to dry in a room which is heated to a high temperature with a forced current of hot air. *(7134)*

Raw silk should not be dried at a high temperature with dry air, as that may harden the gum, make the thread brittle, and increase the breaks in winding. If a drying room is used to get the silk in good shape for winding in a shorter time, use a temperature of not over 110° F. and recirculate the air through the silk one or more times before passing it out of the drying room. Recirculating the air humidifies it, and this prevents rapid drying and casehardening. Depend on air movement to dry the silk within the time limit. Drying slowly on the winding machine is good practice, provided the skeins are opened up and spread out so they dry uniformly.

KNITTING

THE PHYSICAL ANALYSIS OF KNITTED FABRICS FOR COMPARISON AND DUPLICATION*

BY GILBERT R. MERRILL,
LOWELL TEXTILE INSTITUTE

The physical analysis of knit goods may be discussed under two headings: first, the analysis of the fabric only; and, second, the analysis of the fabric and of the garment into which it was made. An analysis of the fabric alone does not take into account the kind or size of garment for which the fabric is made, but does give a basis of comparison if the garments are of the same size and style. An analysis of garments is used particularly for comparison as a means of determining which is the most desirable of several garments or to determine the construction of a garment in order to duplicate it. This article discusses the subject of fabric analysis.

Stitch

The first item to determine in analyzing a fabric is the stitch of which it is knitted. This item is one that can usually be determined by merely examining the face and back of the fabric. Under this heading there are three basic stitches: plain, rib, and purl. There are many modifications and combinations of these, of which the use of the tuck stitch in conjunction with the plain and rib stitches is the most common. Of this tuck-stitch group, half cardigan and full cardigan are very common, while the tuck plain stitch is not.

In determining stitch, care should be taken to classify the stitch, if necessary. There are both plain and rib fabrics of the warp-knit type as well as of the filling-knit type. Then there are plain-stitch backed fabrics. We also find plain, rib, and purl fabrics of the jacquard construction.

*All rights reserved by author.

All fabrics involving a pattern effect need to have the pattern copied as a part of the stitch, because stitch and design are so closely related that they should be treated together.

Width

The width of the fabric is necessary in determining the weight per running yard. It is of value when planning the cutting up of the piece into garments or in determining the garment size if a tubular fabric is to be used for seamless garments. The width of the roll or piece (either split or tubular) should be determined at five different places uniformly distributed along the full length of the roll or piece. The goods should be drawn across a table without tension when the width is measured. The average of the five measurements shall be the width.†

Wales

A wale is a series of loops supporting one another made by the same needle and running lengthwise of the fabric. The wales per inch are used as a measure of the fineness of the fabric, especially when taken in conjunction with the courses per inch. Taken together, these items determine the total number of stitches per square inch in the fabric. This is one way in which textures of different fabrics may be compared.

The wales per inch should be counted along one course and should be given as the average wales per inch in five counts of two inches each, taken at various positions across the cloth while it is laid flat on a table and under no tension.†

It is customary in counting wales to count only those seen. This means that in a 1/1 rib fabric, there are as many more wales on the back as counted on the face, or the figure given represents only half the actual wales.

Courses

A course is a series of loops adjacent to each other, made by one passing of a needles and yarn guide. This series of loops runs across the fabric. The courses per inch is one means of measuring the length of stitch drawn on a machine. The courses per inch vary directly with the length of loop drawn and so are sometimes stipulated as one measure of the texture, as has been previously explained.

The courses per inch should be counted along one wale. The figure used should be the average courses per inch in five counts of two inches each taken across the piece, as in the case of

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counting the wales per inch, with the fabric laid out flat on a table under no tension.†

The wales and courses can well be determined together. One rather common way is to use a one-inch-by-one-inch pick glass and count both the wales per inch and the courses per inch at the same setting of the glass. This method counts but one inch instead of two inches as is recommended by the American Society for Testing Materials. In this way, five positions will take care of both wales and courses. In addition, if the readings are set down in the order taken, multiplying the wales per inch by the corresponding courses per inch will give the stitches for that particular square inch over which the glass rests. If there is any great variation in one item, there should be a variation in the other item in the inverse ratio, or the fabric is of a different texture.

Sometimes fabrics which are finished are subjected to more tension at one part than at another. Where the tension is greatest, the courses per inch should be least but the wales per inch should be sufficient to make the total stitches per square inch the same.

Thickness

The thickness of the fabric should be measured with an automatic micrometer gauge. This gauge records the thickness in thousandths of an inch under a constant pressure upon an area of not less than one-half square inch. Ten measurements shall be taken at different positions in the roll or piece not less than six inches from the selvage. The average of these ten measurements shall be taken as the thickness.†

Notice that up to this point nothing has been done which will distort the fabric and so far the sample has not been cut into in any way.

Weight

The weight of a fabric may be given as the weight per square yard or the weight per running yard. The weight per square yard is the weight of a piece one yard long by one yard wide. The weight per running yard is the weight of a piece one yard long and of whatever width the fabric happens to be.

The weight per square yard is the more valuable as a means of comparison, because if the fabrics do not happen to be of the same width the weight per running yard of one must be converted to an equivalent weight based on the width of the other.

In either case, the weight should be calculated from five sample swatches, 2x2 in., cut from the piece at various intervals throughout its length. These should be cut from the fabric when it is laid out flat on the table and under no tension.† Usually, these samples are weighted together on a grain scale. The total is $2x2x5 = 20$ sq.in.

The weight per square yard would be:

$$\frac{\text{Weight of } 5 \times 36 \times 36}{2 \times 2 \times 5 \times 7{,}000} = \text{Lbs. per Sq.Yd.}$$

The weight per running yard would be:

$$\frac{\text{Weight of } 5 \times 36 \times \text{Width}}{2 \times 2 \times 5 \times 7{,}000} = \text{Lbs. per Running Yd.}$$

There is a very good check on the main items of the analysis which may be used in determining the weight of a fabric. It consists in finding the weight of yarn in one square inch and then converting this to the weight per square yard or weight per running yard. To do this, first find the stitches per square inch of fabric by multiplying the average wales per inch by the average courses per inch. Then dividing the average stitches per square inch by the average stitches per foot of yarn (explained later) gives the feet of yarn in an average square inch of fabric. The feet of yarn divided by three gives the yards of yarn. Then, divide the yards of yarn by the yards per hank of that particular yarn and the result is hanks of yarn per square inch. Then, for cotton, woolen, worsted, or linen, the hanks divided by the counts gives the pounds of yarn per square inch. This can all be put into one expression:

$$\frac{\text{Wales} \times \text{Courses}}{\text{Stitches per Foot} \times 3 \times \text{Yards per Hank} \times \text{Counts}} = \text{Lbs. per Sq.In.}$$

To calculate on a square-yard basis, it is necessary to multiply by the square inches per square yard:

$$\frac{\text{Wales} \times \text{Courses} \times 36 \times 36}{\text{Stitches per Foot} \times 3 \times \text{Yards per Hank} \times \text{Counts}} = \text{Lbs. per Sq.Yd.}$$

When the yarns used are silk or rayon, the size being in deniers, this equation is different. The size in deniers can be taken as the weight in grains of 638 yds. Hence the expression for yarns of this sort is:

$$\frac{\text{Wales} \times \text{Courses} \times 36 \times 36 \times \text{Denier}}{\text{Stitches per Foot} \times 3 \times 638 \times 7{,}000} = \text{Lbs. per Sq.Yd.}$$

The weight in grains of 638 yds. is practically equivalent to the weight in deniers (.05 grams) of 450 meters. The error is considerably under one tenth of one per cent, and is not sufficient to deter anyone from using the English units for any ordinary determinations. The preceding weights would be taken at prevailing atmospheric conditions. If the test is one requiring particular accuracy, the five samples (2 in. x 2 in.) should be exposed in an atmosphere having 65% relative humidity at 70° F. for at least four hours previous to weighing.†

Stitches per Foot of Yarn

The stitches per foot of yarn are, as the name indicates, the number of stitches that one foot of the original yarn will make. In analysis, this is obtained by raveling and finding this item from the number of loops raveled and the length of yarn obtained.

The most satisfactory way of determining the stitches per foot of yarn is to ravel a known number of loops, marking the yarn at the points where counting starts and stops and then measuring this length of yarn. The greatest element of variation will come in stretching the yarn to get this measure. It should be stretched to its original length, which means stretching until all the kinks are pulled out of the yarn but not enough to elongate it beyond its original length. Care must be used on this measurement if an accurate measure is to be obtained.

The stitches per foot of yarn should be counted to correspond to the wales; that is, every stitch for plain and purl fabrics and only the stitches on one side for rib fabrics. Where fabrics are made using more than one feed per machine, a figure should be obtained from every feed. In any fabric, the figure should be an average of five determinations; and, where more feeds are used, an average representing each feed is best.

When more than one yarn is knitted at once, it is necessary to watch to see whether each yarn is used in the same length. This should be checked very carefully, as a similar need is found in raveling for yarn size. Sometimes the difference is very slight but it is well to look closely for it.

Having raveled a definite number of loops and determined the length in inches, the stitches per foot of yarn are found by direct proportion, as follows:

Stitches Counted: Stitches per Foot = Length Measured: 12 in. In this proportion, the number of stitches per foot of yarn is the only unknown and may be determined as follows:

$$\frac{\text{Stitches Counted} \times 12 \text{ (In.)}}{\text{Length Measured (In.)}} = \text{Stitches per Foot}$$

Counts

The counts are the sizes of each of the yarns used in the construction of the fabric. In determining the counts, the yarn is raveled from the sample and measured, and the counts are found in the usual way from the length and weight.

Yarns can often be raveled from a sample directly on to a reel which will give the measured length in one operation. Where more than one yarn is used, care should be taken to see whether

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the individual yarns are used in equal lengths. Very often they are not, especially if the yarns are of different sizes or if one is plated over another. Where the lengths used are not the same, it is better to use two reels; or, if the yarn is reeled on to one reel, to rewind it to get an accurate length of each.

Percentages of Materials

Where a fabric is composed of but one kind of yarn, whether made on a single- or multiple-feed machine, a determination of the percentages of various materials used is not called for. But when two or more yarns run together or are used at different feeds, the percentage of each used may be an important factor, especially in cost finding. Even when used at the same feed, two yarns may be used in slightly different lengths, and, if used at different feeds, it is very likely that the stitch length may be different.

The same pieces that are used to determine the weight can be used for determining the percentages of materials. The ends should be cleared of short bits of yarn left from cutting and the pieces then weighed. The pieces should be raveled, keeping each size of yarn and kind of material in a separate pile. Ravel the pieces as long as they ravel well, and then weigh what remains unraveled. Deduct this weight from the weight of the samples after preparation. The difference should be the total of the various ravelings obtained. Weigh each group of ends separately and check the total against that figure just obtained. Divide the weight of each size or kind of material by the total weight raveled to find the percentage of each.

The yarns raveled for the determination of yarn size may be used for determining the percentage of materials used. If the yarns are raveled so that the whole fabric is represented and all the yarns for the portion of the fabrics used, the various skein weights can be totaled and the percentage of each material found by dividing the total into the respective skein weights.

Total Needles

The total needles are all those required to knit the fabric of the width given. This figure can be found by actually counting the total number of needles in the piece, or it may be found by multiplying the wales per inch by the width of the piece in inches for plain and purl fabrics, or the wales times the width times two for 1/1 rib fabrics. The particular value of this figure is as a means of establishing the approximate cut of the machine.

For plain machines with needles removed for drop-stitch effects, the needles omitted should be counted as there are slots in the machine for those needles even if not used.

Similarly for fancy rib stitches the needles omitted to form the broad ribs should be counted, since here, as in the plain machine, the slot and space for each needle omitted is present and really used even though the needle is taken out.

Estimated Width or Diameter

For flat machines, the estimated width is the width in inches of that part of the needle bed used. Considerable experience and judgment are necessary to correctly estimate this figure, as a variation in length of stitch varies the amount which the fabric contracts in width from the original needle-bed width. Also a different type of stitch will cause a different contraction in width.

On circular machines, there is the same amount of judgment necessary in estimating the diameter as is necessary in estimating the wid h for a flat machine. However, the nearest general rule that can be established is that the width of the flattened tube coming from a circular machine is *about* equal to the machine diameter. Very often the width is less than the machine diameter and sometimes it is greater, especially if a cardigan stitch is used.

Estimated Cut

The cut is the number of slots per inch in one needle bed or along one inch of the circumference of the needle cylinder. In flat machines, the cut is generally a whole number of needles per inch, although for very coarse work 2½ cut is commonly used. In circular machines, the cut is seldom a whole number of needles, because the diameter is generally an even number of inches (or even quarters of an inch on small machines) and the number of needles is some convenient number such as 160 or 120. Consequently the cut usually comes to a fractional number.

Cut is estimated here only in that the estimated width or diameter is used in obtaining it, for the cut is the total needles divided by the width or circumference in inches. The above is for plain machines. If the fabric is rib, the cut is one-half the total needles divided by the width or circumference in inches.

CHART FOR FIGURING OUTPUT OF KNITTING MACHINES AND RELATED PROBLEMS

By A. S. Mark

Figuring the output of circular knitting machines for various types of work can be done most rapidly and simply by means of a properly designed chart. The following problem will first

be solved by the every-day long-hand method, and then graphically, so as to show the comparative simplicity of the latter method.

A mill has twelve frames of eight feed each, running with a cylinder speed of 28 r.p.m. The fabric has 24 courses per inch. We want to find the total production in yards per hour.

The general formula for the production of circular knitting machines is as follows:

$$\frac{\text{(Speed of frame)} \times \text{(Feeds)} \times \text{(Frames)} \times \text{(60 min.)}}{\text{(Courses per in.)} \times \text{(36 in.)}} = \text{Production in yd. per hr.}$$

$$\frac{(28 \times 8 \times 60 \times 12)}{24 \times 36} = 187 \text{ yd. per hour.}$$

Time is required to multiply the four numbers of the numerator and divide by the product of the denominator. This same problem has to be solved over again whenever any one of the above variables changes.

Graphical Solution

Now for the graphical solution. The chart consists of five vertical lines, four of which are calibrated. The first line to the left shows the cylinder speed of the frames. The second is a pivot line. The third represents the production of any number of frames in yards per hour. The fourth represents the number of frames. The fifth is for the courses per inch.

To solve the above example graphically, lay a straight edge from 28 r.p.m. on the first vertical line to 12 frames on the fourth line, as shown by dotted line 1. Now join the point *A*, where the pivot line is intersected, with 24 courses per inch on the fifth vertical line, as shown by dotted line 2, and read the answer to the problem, 187 yd. per hour, instantly upon the "yards-production" line.

Other Factors

Many other factors can be found, aside from the yardage produced, with this identical chart. For instance, we may want to know how many eight-feed frames would be required to give us 220 yd. per hour, if the machine speed is 24 r.p.m. and the courses per inch in the fabric are to be 18 courses per inch. Actually we would have to proceed as follows:

$$\frac{\text{(Courses per in.)} \times \text{(Yd. per hr.)} \times \text{(36 in.)}}{\text{(Cylinder Speed)} \times \text{(60 min.)} \times \text{(8 feeds)}} = \text{Number of frames.}$$

Graphically, simply lay a straight-edge from 220 yd. per hour on the production line to 18 courses per in. Project it back to where it cuts the pivot line at *B*. Then join *B* on the pivot line with 24 r.p.m. on the cylinder-speed line, and read the answer on the number-of-frames line. Since the answer

is 12½ frames, 13 frames will be required to take care of the production.

It goes without saying that this chart can be designed to fit the requirements of any mill, with frames of any number of feeds, and anyone can design and use the chart with little technical knowledge. With equal ease we can find and predetermine

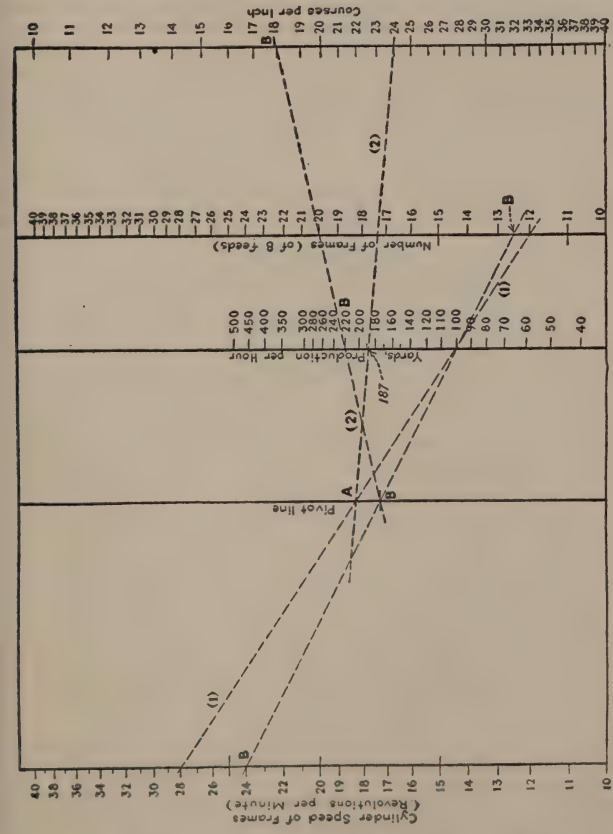


Chart for the Solution of Knitting Problems

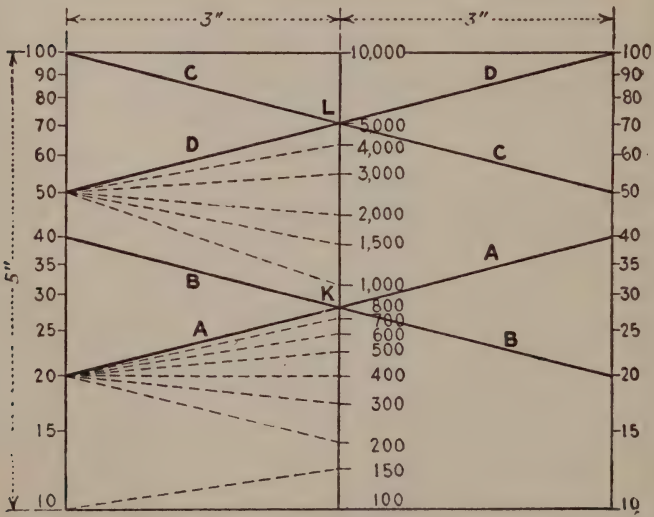
the cylinder speed of the frames to give us any desired production for any number of frames on any fabric construction. Elimination of calculations, besides saving time, reduces the possibility of errors.

Construction of Nomographs

There is nothing mysterious or complicated in the design of a chart of this type, although the ease with which problems are solved seems to amaze and mystify those not familiar with its construction.

Take, for instance, a simple graphical multiplication or division. We will say that the practical limits decided upon are a minimum of 10 and a maximum of 100, so as to make the process very simple.

Plot a simple logarithmic scale vertically on a piece of paper 5 or 6 in. high, beginning with 10, which has a logarithm of



Illustrating Method for Designing a Calculating Chart

1.00, and concluding with 100, which has a logarithm of 2.00. Find from the tables and plot the logarithms of as many intermediate points as may be desired. Six inches to the right draw another line parallel to the first and calibrate it exactly as the first, so that its various points correspond with the same points of the first. This method is an empirical one, but a very easy one to use and is sufficient for practical purposes. It eliminates entirely "moduli," formulas, and other technicalities that add

considerably to the confusion of those not experienced enough in their use.

To complete the chart we must locate the product line. Again the empirical method is the most practical. We do not know where the product line will be, but we do know that the point of intersection of a line joining 20 on the first line with 40 on the second line (see line *A*, Fig. 2) and another line joining 40 on the first line with 20 in the second line (see line *B*) will intersect at a point *K* which lies on the product line, and that that point will be the product of 20x40 or 800. In a like manner, line *C* and line *D* will cross each other at the point *L*, and that point is also on the product line, its value being 50x100 or 5,000. Now we draw a line joining *K* and *L*, extending it on either side, and begin calibrating it from any convenient points, say 20 and 50 on the first line. Dotted lines from the point 20 to 10, 15, 20, 25, and 30, etc., on the last line give us the various subdivisions on the product line *K-L*.

If the Scale Is Dissimilar

It is often the case that the scale of the two lines is dissimilar, in which case the product line will not be exactly equidistant from the parent lines. Again, in such a case, the empirical method explained above is by far simpler and more practical than the technical one.

Division by means of the chart is accomplished by using the first and second lines as parent lines. The third line then gives the result.

Interesting facts concerning

STRENGTH AND ELONGATION OF HOSIERY AND OTHER KNIT GOODS

By William Davis

The machines used for tensile testing of woven fabrics are already well known and standardized, the usual form having a test piece of fabric stretched between two jaws. The movable jaw is made to travel away from the other when the machine is set in motion, and, as the fabric tightens and breaks, the strain is registered on a dial in pounds. A scale shows the

difference between the original length of the test piece and the length at which it breaks, which is stated as the elongation of the sample.

Four-Inch Jaws

Now many strain-testing machines have not proved suitable for similar testing of knitted fabrics, owing to the insufficiency of the scale for registering the elongation, as the knitted texture is usually several times more stretchy than the woven texture. The writer uses a vertical machine for this purpose in which the width of the jaws is 4 in., just about the width of a hose in its tubular state, and special provision is made for a very long elongation register so that it is adapted to working on the knitted fabric.

The machine is operated by a small motor so as to have a perfectly level rate of loading, and the jaws are set to travel regularly at a uniform rate. The machine is also set to return automatically to the starting position after the fabric has been broken, which is a considerable saving of time in the manipulation of the machine. It is an advantage to have the rate even and fixed, as it is well known that the test result can be varied within wide limits according as the test is made slow or fast, a fast test generally giving a higher result than a slow one.

The condition of the material is also important, and it is advisable to establish a standard of moisture and to see that this is attained by hanging the samples in a conditioning room where the moisture content is controlled and regular. A better way is to have the testing done in a room where the atmosphere is retained at a constant humidity; but if this is not possible, it is satisfactory to hang the samples to be tested for about two hours in a conditioning chamber and to withdraw them one by one as the tests are being undertaken.

Number of Tests Necessary

In a piece of fabric, it is usual to make a number of tests on this machine widthway, followed by a number taken lengthway in the fabric. In mill practice it is not customary to take more than two or three tests, owing to the waste of material incurred; but for the following experiments a series of ten tests has been made at each stage.

In the case of stockings, however, testing by such a method or any other is fraught with peculiar difficulties for in one article there are a number of distinct variations of material and of

texture. The top or panel of the hose, for example, has one texture and the silk portion as far as the calf is of another material. Very often in the cotton panel there is a slack texture at the very top, which is tightened up toward the bottom of the portion. When the calf of the hose is reached, there are a large number of variations of texture due to the stiffenings made on the automatic hose machine to give the narrowing for the ankle. As the stitch is tightened gradually over this portion, the tensile properties are also continually changing. Then the bottom of the foot is spliced, while the top of the foot is plain material. To test the whole article therefore requires about half a dozen different stages, each stage demanding a number of tests in length and width.

These difficulties were met in the following manner. The article chosen was a seamless automatically made hose worked on the Model K hosiery machine. The test areas were taken as 4 in. wide and 4 in. long. The pieces of this dimension were stretched between the jaws, and the results in breaking strain and elongation read off.

The set of the knitting machine was 54 gauge, having 260 needles in a diameter of 3½ in. with graduated stiffening from calf to ankle. The cotton top was made from 42/2 mercerized cotton; and the heel, toe, and foot bottom were spliced with 80s cotton. To obtain sufficient length of fabric to yield an adequate number of tests, the machine was set at the texture of definite portions of the hose and several yards of tubular fabric were worked. For example, in the cotton top, one series of tests are given, then at the top of the leg, another series. Another test series was made at the commencement of the graduated stiffenings; another series in the middle; and another at the end. The final range of tests was made along the foot bottom with the splicing inserted. At each stage the knitting machine was set to the texture concerned and a few yards of fabric run off for the purposes of the test.

There can be no doubt of the advantage of making the tests in the direction of the fabric length in double-ply, but as regards the width, the 4 in. plus the biting portion could not be obtained from the hose as it stood—therefore this was cut single and the test made in the single piece. In testing for the single fabric, one would have thought that it would tear at one point very easily as compared with the double form, but in practice it was found that the breaking strain of the fabric tested two-ply was little more than twice that obtained from testing the single fabric, and for all practical purposes the breaking strains two-ply can be halved to give the equivalents in single-ply.

Results of Tests

Test 1 Cotton Top of Hose

Test Area: 4 in. x 4 in.
22 stitches per in.
28 courses per in.

Test No.	Breaking Load Lengthwise — Double Fabric in Lb.	÷2, or Single Fabric in Lb.	Elongation of Test Piece in In.
1	186	93	2.25
2	180	90	1.75
3	188	94	1.75
4	201	101.5	2.25
5	178	89	1.75
6	188	94	1.5
7	188	94	1.5
8	190	95	1.75
9	179	89.5	1.75
10	196	98	1.5
Ave.	187.4 lb.	93.7	1.8

Test 2 Cotton Top of Hose
Taken in single-ply, widthway.

Test No.	Breaking Load in Lb.	Extension in In.
1	27	6.25
2	24	6.75
3	20	6.25
4	23	6.25
5	20	5.74
6	27	6.5
7	20	6.0
8	17	5.75
9	21	6.25
10	23	6.0
Average	22.2 lb.	6.3 in.

Test 3 was taken lengthwise at the commencement of the leg portion, which was composed of 40s-2 mercerized cotton, 23 stitches per in. and 33 courses per in. The ten breaks on the double fabric averaged 171.4 lb., or about 85.7 lb. on single. The average lengthwise elongation averaged 1.7 in.

Test 4 was taken widthway on single-ply fabric at the same place that test 3 was taken. The average of 10 breaks was 22 lb. The average elongation noted at the same time was 7.2 in.

Test 5 was taken lengthwise at the start of the graduated stiffenings or fashionings. The fabric at this point was composed of 42s-2 mercerized cotton, 24 stitches and 29 courses per in. The average of ten breaks on the double ply was 159 lb. The estimated average of ten breaks on the single was therefore 79.5 The average elongation was 2 in.

Test 6 was taken widthway at the same place on single ply. The averages were 29.2 lb. and 6.9 in.

Test 7 was taken lengthwise at the center of the graduated stiffenings or fashionings, 25 stitches per in., 33 courses per in. The averages were as follows: double ply 160 lb., 2.7 in.; single ply (estimated), 80 lb.

Test 8, taken widthway on single ply at the same place as test 7, averaged 42.6 lb. and 5.1 in.

Test 9 was taken lengthwise at the end of the graduated stiffenings or fashionings, where there are 29 stitches and 37 courses per in. The double-ply breaks averaged 154 lb., or 77 lb. in the single, and the elongation averaged 2.4 in.

Test 10, taken widthway on singleply at the same place as test 9 averaged 42.6 lb. and 5.7 in.

Test 11 was taken lengthwise on double fabric at the foot bottom, one-half of this section was composed only of the 40s-2

Fig. 1

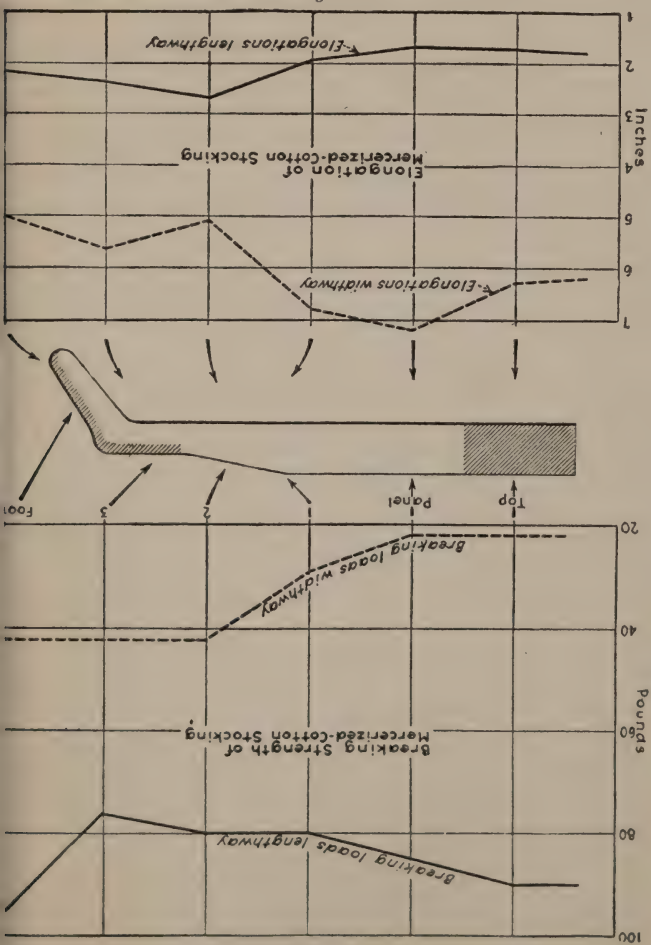


Fig. 2

nercerized cotton. The other half was reinforced with 80s cot-on splicing yarn. This construction made it inaccurate to take

the break of the single fabric as one-half that of the double. The average results on the double were 192 lb. and 2.2 in.

Test 12 was taken on the spliced or reinforced part of the foot bottom widthway, and averaged 42.6 lb. and 5.1 in.

Comparison of Width and Length

A scrutiny of the above results reveals several very outstanding properties of the knitted hosiery fabric; viz., (a) the enormous strength in the vertical direction as compared with that in the width, and (b) the enormous elongation in the width direction as compared with that in the length. These points may be summarized as follows:

	Breaking Load		Length		Width
Cotton panel	93.7	÷	22.2	=	4.2
Top of leg	85.7	÷	22.0	=	3.9
Graduated stiffening 1	79.5	÷	29.2	=	2.7
Graduated stiffening 2	80.0	÷	42.6	=	1.9
Graduated stiffening 3	77.0	÷	42.6	=	1.8

In the above comparison the breaking load of the length as compared with the width varies from 4.2 to 1.8 times. As the fabric becomes stiffer, the strength in each direction differs to a less extent, but even there it is always about twice as great in the length as in the width. This is explained by the way in which the loops support each other in the length, while in the width the stretching of the fabrics appears to throw the strain more on to the individual courses or threads.

A similar comparison of the elongation is made in the following, except that the details of the width are placed over those of the length, thus:

	Elongation		Width		Length
Cotton Panel	6.3	÷	1.8	=	3.5
Top of leg	7.2	÷	1.7	=	4.2
Graduated stiffening 1	6.9	÷	2.0	=	3.45
Graduated stiffening 2	5.1	÷	2.7	=	1.9
Graduated stiffening 3	5.7	÷	2.4	=	2.4

In the slack cotton panel the elongation in the width is 3.5 times that of the length, and the middle stiffening shows the least elongation, but this is nearly twice the elongation shown by the length.

Usefulness of Method

It is suggested that this method of investigation will prove useful to knit-goods manufacturers in a variety of ways. It can be used to elucidate certain points of dispute which often occur with wearers, and a thorough test of the tensile properties on the lines indicated can be made to yield useful data of practical value.

In certain types of rayon, for example, it is often averred by the wearer that there is insufficient elasticity at the calf of the leg in the seamless article, and in those instances the main test would be that of elasticity of the calf portion across the hose. A number of articles are cut across at this point and a series of tests made in the manner explained. This will show how the tightness is caused, and will afford some guidance as to what steps in knitting should be taken to remedy this defect. For instance, it may be that a more elastic stitch can be made on the knitting machine to give greater stretch.

In certain types of articles the top panel is inclined to be too stretchy and goes out of shape when worn a few times. A width-elongation test of this portion will reduce this item to a specific percentage, and the knitting stiffness can be increased to maintain this at a correct standard.

Then there is a further suggestion for the use of this method of testing, and that is in the way of advertising the goods. It is often very effective when wording an advertisement explaining the merits of hosiery to give a few figures showing the elasticity and breaking strain as compared with other makes. A few figures displayed in a telling manner create a forceful impression, and often serve to convince the thoughtful reader.

The results of the strength tests reported in the foregoing are shown graphically in Fig. 1. The solid black line shows the breaking loads of the fabric lengthway of the knitted texture, while the lower dotted line gives the corresponding breaking loads widthway. The relative positions of the two lines is illustrative of the great disparity of these properties when compared in length and width. Fig. 2 gives the corresponding elongation results in inches of the 4-in. test shown in Fig. 1. The upper dotted line shows the elongations widthway, and the lower, solid-black line shows the elongations lengthway. It will be noted that in Fig. 1 the upper black line is high above the width line, but that in Fig. 2 the positions are reversed.

Tests on Rayon Stocking

The following discussions are based on a further series of tests made on a standard type of hose which was produced on the automatic hose machine. In this hose the leg portion was knitted in rayon yarn. A set of five tests were made from four distinct portions of the hose.

The following shows average breaking strengths:

Part	Average Length Breaking Load in Lb.	Average Width Breaking Load in Lb.
Cotton top	81.6	46.6
Cotton panel	88.5	48.4
Rayon leg	61.3	20.4
Cotton spliced foot	55.5	36.2

These results are shown graphically in Fig. 3. The length results are given in the solid black line; and the width figures, in the dotted line. Again in Fig. 4 the relative positions of the two lines are reversed, the dotted line for the width elongation taking the higher place, with the following summary of averages:

Part	Elongation in Length in In.	Elongation in Width in In.
Cotton top	2.1	5.3
Cotton panel	2.4	3.9
Rayon leg	1.9	4.8
Cotton spliced foot	3.25	3.3

In the above series, there is a wide margin of difference shown in the slacker cotton top as compared with the panel lower down. In each case the 4-in. test piece in the length stretches over 2 in. before it breaks, giving an elongation of over 50%. Crosswise, however, the elongation is more than double this as a minimum, some samples having an elongation of 120% in the width.

This example is given to illustrate the method, and it is evident that it can be used in many ways by the careful manufacturer to determine problems of stretch and strength which arise in his business. To take one example, the effect of finishing and processing can often be conclusively demonstrated, particularly as they affect the widthway stretch of the knitted fabric—a vital matter in the rayon seamless hosiery trade.

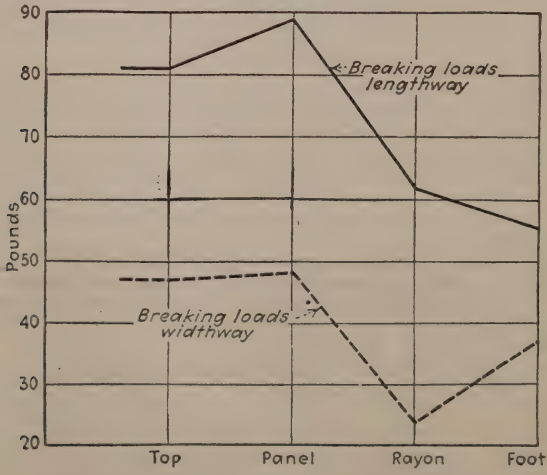


Fig. 3
Breaking Strength of Rayon Stocking

The following examples illustrate how the method can be applied also to the knitted-web trade. The results of two exhaustive series of tests are given. Twenty tests were made each way, lengthwise and crosswise. The fabric is a standard type of cotton web, 8s count, worked in plain stitch on a latch-needle circular web machine having 10 needles per inch. In this case the test pieces were taken 4 in. wide and 7 in. long. They were cut from the web with the assistance of a template measuring the exact size. To get through the tests fairly quickly, these were set into the upper jaw in position so that each succeeding piece could be rapidly brought down and clamped into the lower jaw. It was, of course, important to have them all taut at the same tension, and a suitable weight has hung on the sample to achieve this before the strain was applied.

The average of the twenty tests in length was 139.9 lb. and 4.6 in.; and in width, 67.25 lb. and 6.68 in.

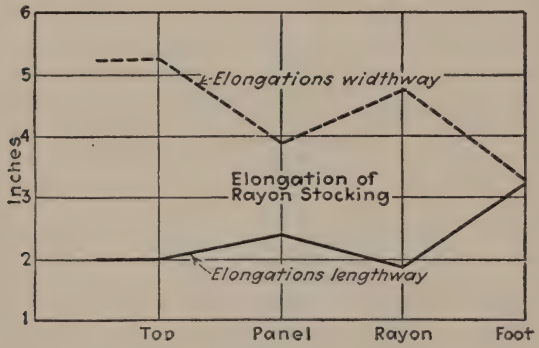


Fig. 4

In these tests the same general properties of the knitted fabric are again clearly demonstrated. In the length direction 7 in. stretches 4.6 in. before breaking, which amounts to 65.7%. Widthway a length of 7 in. stretches 6.68 in. or nearly 100%. What is lost in elongation in the length is made up by the extra load which can be borne—139.9 lb. as compared with 67.25 lb., or very nearly double. This is interesting when one considers that a knitted fabric is a unithread structure, constructed throughout from the same yarn.

Hosiery manufacturers buy enormous quantities of cotton and silk beige or sateen cloths with which to trim and ornament these fabrics. These are woven fabrics selected because of their strength and rigidity for use at such places as fronts and bands, where no yield or stretch is necessary or desirable. The manu-

facturer seldom thinks of testing these cloths, but it is recommended that this should be done before fixing contracts for supplies, as great differences can often be detected by this means.

NEEDLE BREAKAGE IN FULL-FASHIONED HOSIERY PLANTS

Technical Editor:

What is a reasonable needle cost per dozen for a full-fashioned hosiery mill? Last year our cost was approximately 4c. per dozen, which appears to the writer abnormally high and which could be accounted to many reasons—chiefly, the training of new help and the putting of new men on fine-gauge machines running picot, etc.

We would like to know what methods are satisfactory for creating a deeper interest in the knitter for the care of his needles, to cut his waste to a minimum. In one of the Philadelphia full-fashioned hosiery mills where the writer was employed for a short while, it was the policy of the firm to credit each week 50c. on each knitter's pay, and on each package of needles he received he was charged 50c. We want a system that will not work an injustice upon the knitter. (7177)

This question, like Mark Twain's statement about the weather, is one that has had much said about it and very little done about it. Needle breakage is traceable to so many different causes that we doubt if there has ever been or ever will be established what could be considered a universal standard of cost per needle or per dozen. Neither will there be very many mills found with parallel needle costs.

The life of a needle in the first place depends on the grade of steel and the tempering of the needle as supplied by the needle manufacturer. Until very recently, tempering of needles was carried out largely by the rule of the thumb, and we understand it is still something of guesswork on the part of many needle manufacturers. This means at the outset that a manufacturer may get one batch of needles tempered too hard and another too soft, either of which greatly shortens the life and usefulness of the needle.

Granting that this condition could be absolutely corrected and needles of uniform and satisfactory standard supplied, it will still be found that one manufacturer is overloading his needles by knitting fabric too heavy to be best suited to the gauge of the machine; another may be found doing the exact reverse—knitting fabric entirely too light or close for the gauge of the

machine. Either condition seriously impairs the life of the needles.

Other operators will be found running their machines at excessively high speed, which tends to crystallize the needles and shorten their life. In addition to these conditions there is always the possibility of heavy yarns, knots, etc., causing excessive needle breakage. To this will be added other mechanical troubles of the machine which sometimes develop, breaking practically every needle in the machine. The final, greatest hazard of all is the training of new knitters.

We believe it would be thoroughly possible to demonstrate that all different gauges of machines can be operated under the same relative conditions with a relative cost of needles per dozen. We mean by this that a 36-gauge full-fashioned machine working under the conditions best suited for a 36-gauge machine will break just as many needles per dozen as a 48-gauge machine working under the same relatively best-suited conditions for the gauge. We believe that in a well-organized full-fashioned mill in which machines are operated in the main with trained help, needle cost can be reduced to a uniform figure of around 2c. per dozen, or slightly less. However, we consider a consumption of an average of two needles per dozen, when all hazards of the needle are taken into consideration, as being a good average of cost.

We suppose that there are a great many methods for creating a deeper interest in the knitter for the care of his needles, but probably no method is as good as maintaining well-trained knitters and keeping them under careful supervision. We dislike all methods of bonuses, charges, etc., for this purpose. If a knitter is misinformed, the mere charging him or crediting him with 50c. or $1.000 each time he gets a package of needles will have very little effect in correcting his shortcoming. If he is misinformed, it should be his foreman's place to see that he is carefully and correctly instructed. After such instruction he should be given a chance to take care of his needles, machine, and production; and, if he fails, a more cooperative knitter should be given his place. We believe any system different from this will work an injustice on the employe.

It is the foreman's duty to know the characteristics of each individual knitter under his supervision. It is also his duty to know what is a satisfactory standard of needle breakage for his plant. If each knitter is assigned a definite quantity of needles and records are kept, there should be no trouble in isolating knitters and machines giving an excessive amount of trouble. The trouble may then be corrected by removing the cause, which might or might not be the knitter's fault.

Of the penalty methods used for influencing knitters toward greater care of their needles, probably none is so good or so widely adopted as the one you have mentioned; i.e., crediting them with 50c. and charging them that amount for each package.

But even with such a system, it is desirable to insist upon a high quality of work and upon top production. This will make it necessary for the men to keep their needles in good shape. It has also been found desirable by some mills to deduct from the knitter's credit a good stocking for every bad one passed in for good, in addition to deducting the bad one.

We repeat that there is nothing so good as personal supervision in this matter, and we know that alert foremen make a practice of going among the machines at intervals looking for broken selvage needles and needles out on selvage, throwing out the needle bar and raising the fabric to the top of the needles in order to see whether there are any low beards, etc. This method seems to influence the knitters toward caring for their needles more than any other.

SMALL SPOTS ON FULL-FASHIONED HOSIERY

Technical Editor:

We are enclosing herewith a six-thread, Grand XX, 48-gauge pair of stockings. The fabric in our estimation does not look right, and it is our desire to have you explain wherein the trouble lies.

The silk is backwound wet with a 2% solution of sulfonated olive oil. To this solution we add 1 oz. of olive-oil powdered soap, which is brought to a solution in a separate pail and then added to the above solution. The silk is then taken to the knitter humidor, where it passes over a roll wet with a solution of Silklubric No. 26. This solution is made heavy enough to carry it over the roll and is composed of approximately 6% Silklubric No. 26 and 94% soft water. It is our belief that the solution is not correct, either on the backwinder or knotting machine.

We would also like to know what is the correct solution for running three-thread 94%, five-thread XXX, and six-thread Grand XX. *(7218)*

The defect in this hosiery is not the usual defect which we attribute to improperly backwound silk; i.e., sleazy stitches. The surface of the goods, both inside and out, is remarkably free from fuzz and shows little or no broken filament, which is proof that the threads are well lubricated. The evenness of the silk is extremely good for a hose so sheer. There are few bands which show up in the upper calf of the leg. The feel and handle of the stocking is most excellent.

The defect as we see it appears to be a short drawn stitch here and there, which at first we were inclined to think was a pull. From a casual examination one would attribute the cause of this to the machine in which the goods were boiled off. If

they were boiled off in a beaker in the laboratory, the trouble might have been caused by the use of a sharp glass rod.

A more careful examination under the microscope, however, shows these to be a flake-like deposit of a soap or a soap-like substance. This has become imbedded in the stitch and has not come out in the boil-off. Even pure soluble soaps in a fine undissolved form do not readily come out in the boil-off, unless the boil-off be severe; and this hose could not be considered as boiled off too much.

From the formulas you have given us we are inclined to believe there are three possible places where this deposit might have been formed.

In the first place, there is a chance that the powdered olive-oil soap is dissolved only partially. This material is so finely divided that there is a possibility that some of it might get into the solution in the undissolved form and escape detection. A very small flake could spread to about the size of the spots if softened up but not put into a true solution. We would suggest boiling this soap 15 or 20 min. to insure complete solution, and we would have the water boiling before we added the soap. As a final precaution, we would strain it through cheese cloth, to be sure that no undissolved soap found its way into the backwinding trough.

Many mills do not add soap to sufonated olive oil. Sulfonated oils are generally finished on the free fatty-acid side, and a soap solution is always alkaline, due to hydrolysis. When these two unite there may be a danger of a curd forming.

The second place where these soap-like flaky curds could form is in mixing up the Silklubric 26 solution. It is true that this product is a liquid, but it does not mix as readily with cold water as it does with hot water. When mixed with cold water, there are some portions which do not mix readily because the chill of the water hardens them up. When mixed with hot water, these are dissolved and enter a perfect solution.

Many mills have used Silklubric 26 extensively and obtained better results when using hot water. We might mention the fact that it is not necessary to use as much as you are using. For five and six threads it is satisfactory to use 4 oz. to the gal. which is 4 to 128, or about 3%. For a three-thread tram it is sufficient to use 3 oz. to the gal. Some mills obtaining satisfactory results use Silklubric 26 in the backwinding machine and nothing but clear soft water on the knitting machines.

You should be very careful to see that no scum or lint forms on the roller or in the trough. You should clean these parts each week.

The third possible cause may lie in the fact that you are using a galvanized pail to mix up your solutions. When these are used, there is always a coating of zinc soap which forms on the sides of the pail. This is rubbed off and finds its way into

the machine and subsequently onto the silk. This is very hard to remove. White enamel pails are desirable for use in making these solutions.

BAD CAST-OFF ON SELVAGE OF FULL-FASHIONED HOSE

Technical Editor:

Enclosed find a section of a full-fashioned leg knit on a 42-gauge machine for your inspection. I have some trouble with one machine "loading" in the first narrowing, which you will find in the sample. I would like to have information as to the cause and the method for correcting this trouble. I have tried raising and lowering the narrowing machine and knocking-over bits, have added more weight on the take-up roller, and have adjusted the needles, but have not obtained any improvement. Any information you can give me will be greatly appreciated.
(7152)

We find that this loading of the needle or bad cast-off is not at all associated with the narrowing. This is evidenced by the fact that narrowing is perfect on one selvage, and that the loading occurs between the narrowings on the selvage where the trouble is to be found.

This trouble can be traced to several different sources, such as an unlevel needle bar, needle bar out of line with sinker head and folding bar, needles out of line in needle bar, or badly adjusted take-up straps. The most probable cause is poor alignment of needles in the bar. In any case it is evident that trouble is caused by needles not having sufficient pressure at the time of cast-off of stitches at the point where the trouble is located. The chances are that careful investigation will show that needles have been pliered out of line; and while they might appear straight in the bar, they will show to be out of line if properly gauged. We feel sure that if careful attention is paid to adjusting of needle bar and needles, sinker head, and folding bar, the trouble will disappear.

UNEVEN LENGTHS OF FULL-FASHIONED HOSIERY

Technical Editor:

I am having great difficulty in keeping lengths of full-fashioned silk hosiery even, and have come to the conclusion that my trouble is in the felts through which the silk runs on the machine. I am enclosing one of these felts. This is placed

in the usual water trough, both ends being folded to the center. I would appreciate it very much if you could send me something that would assist me to get better results, using the present water trough. (6732)

There are many known causes for uneven lengths and probably as many more that as yet are unknown. There are so many arrangements to dampen the silk, and most of them good, that it is very difficult to suggest a correct method to suit all conditions. Our only comment on the felt submitted is that it is much larger than necessary, and the replacements must be quite expensive. But there seems to be no reason why a set of these felts, all cut the same, curled around in the same circle, producing the same tension in the "split," would not be quite all right.

Is it possible for the lather or water to break contact with some felts and not with others? Does your lather change its consistency under changing atmospheric conditions? Is your winding department careful to wind each bobbin with the same tension and to avoid mixing the different numbers of silk? Do the winders' troughs run dry or, if lather is used, is it always of the same consistency? Do you buy from different silk men and mix the silks? (The silk man will tell you not even to mix his own lots.)

The trouble may not be with the silk. It would be a good plan to go to a machine with varying lengths and have the knitter take down a bobbin that has produced a short leg, and also one that has made a long leg. Reverse the silk. Then if the lengths are not changed, the fault is probably with the machine. Look for a cut guide, tension ring, snapper, tube, or anything the silk must pass over on the short section. We would expect to find no tension, slurcock drawing too much loop, or some cause for a loose fabric in the long one.

DETERMINING GAUGE OF FULL-FASHIONED HOSIERY

Technical Editor:

Can you advise us of a method to determine the gauge of finished full-fashioned hosiery? We have been told that this can be done by counting the number of needles at the widest part of the stocking; that is, the portion above the fashioning marks, and dividing this by 14, then multiplying by 1½. If the result has a fraction, it is taken as the next gauge (i.e., 39.7 would be 42 gauge). However, this method is not exact unless it is known whether a 14- or 14½-in. needle bar was used in the manufacture of this stocking. It must also be known whether all the needles in the machine were in action. We

would appreciate your explaining to us any other method you know of.

Also please answer the following questions for us: (1) From the finished stocking is it possible to definitely state the size needle bar used? (2) Is it possible to determine whether all the needles were in action? (3) How can the gauge of men's full-fashioned hose be determined? (6743)

It appears from this inquiry that the reader is as fully acquainted with the determination of the gauge of full-fashioned hose as it is possible to be. The only comment that can be added is the value of judgment based on a considerable experience with known samples.

So far as we know, there is no way of telling the size of needle bar used, nor whether all the needles were used, from the finished stocking.

The method of determining the gauge of half hose is similar to the method for full hose, on the assumption that a 10-in. needle bar is used. Here again there is the possibility of dropping some needles, and there is no way of telling when this is done.

PARTICULARS OF FULL-FASHIONED MACHINES AND STOCKINGS

Technical Editor:

(1) Is the 14-in. needle-hand or needle-space machine most commonly used in this country?

(2) What other needle spaces are used?

(3) Must all the needles in the 14-in. spacing be used if this machine is used? In other words, can the traveling carriage be set in such a manner that it travels, say, 13 in. or 13½ in. while knitting?

(4) I have been informed that the carriage may be so set as to knit any width of fabric on a 14-in. space, provided the needles are dropped in groups of fours. Thus, if a manufacturer has 14-in. needle spacings on a 42-gauge machine (in which case the total needles would be 392), he may set the carriage in such a manner that only 388, 384, 380, 376, etc., needles are knitting. Naturally the width of the fabric would be less. Is the foregoing true?

(5) In the example indicated at (4), would the hose knit be a 42-gauge stocking regardless of the number of total needles used?

(6) What would a stocking counting 394 needles in the welt (above the first narrowings) be classified as (gauge), when knit on a machine with 14-in. needle space? 13½-in. needle space? 13-in. needle space?

(7) Is there any way of determining positively the gauge of a stocking from an examination of the finished hose?

(8) Is it fallacious to attempt to compare the closeness of texture of two stockings of the same trams (same strand and denier silk) by counting the total needles and determining the gauge (assuming both to be knit on machines with 14-in. needle heads)?

(9) Is there any tabulated data in printed form showing the least possible number of needles that may be used with the carriage set to travel 13, 13½, 14, and 14½ in. and maintain the various gauges? In other words, do any textbooks or other publications show a table of gauges and total number of needles for these gauges when knit on machines with the various needle spacings? (6779)

(1) This is recognized as a standard width and is what is supposed to be on all machines except for outsize.

(2) For half hose 10 in. is a standard width.

(3) The yarn guides may be set for any traverse, using the width desired.

(4) Yes.

(5) The gauge of the stocking depends entirely on the needle spacing or needles per inch; 42 gauge regardless of width.

(6) 14 in. = 42 gauge; 13.5 in. = 43.8 gauge; 13 in. = 45 gauge.

(7) There is not.

(8) No. Ordinary comparisons are made this way, using same judgment in the final settlement of the question.

(9) We know of no printed matter along this line.

It must be clearly understood that the matter of gauge is a fixed thing. While some manufacturers may try to reduce the material in a stocking and the cost of parts by using a narrow needle width, the gauge still depends on the needle spacing. If there are 28 needles per inch, it is a 42-gauge, regardless of other factors. Using the same total needles on a narrower width changes the gauge, while merely reducing the width and needles in proportion does not.

VARIATIONS IN FULL-FASHIONED FOOT AND LEG

Technical Editor:

We are enclosing several pairs of stockings made on our new machines. We are having considerable trouble with the variation in the foot and leg. Can you tell us what causes this and how it can be eliminated? We use 3½ turns for twist and the best grade of silk we can buy. For a while we used a conditioning room to moisten the silk, but we are now backwinding over a solution. Which method do you think is best? Any other information you can give us will be greatly appreciated. (6917)

Upon carefully examining the hose submitted we notice three legs are from one machine and two from two other machines, whereas the feet seem to be four from one footer and one from another. It would appear that your leggers are not making the fabric of one general stiffness; i.e., they are not putting in the same courses per inch consistently. The footers are apparently behaving likewise. Hence you are getting this difficulty in matching.

The "dry" knitting seems to be due to the silk remaining in the machine too long, or to its not being kept in damp boxes, or to some similar cause. A good idea is to wind only sufficient on a bobbin or cone to last the knitter one day, which will cause the silk to be used up before it is dry.

One instep is very much too tight, causing a very bad match for the leg, and the cause is most likely the rag, wick, or whatever is used for tension in knitting, making too great a tension and causing this tight condition.

The most practical thing to do would be to have the leggers and footers number a set coming off the machine, and have them counted and measured, etc. Then each section should be gone over in order to make even work, which is by far the greatest need shown by the samples. Much of the fabric is really beautiful, which indicates that the winding and the solution are satisfactory. Tight fabric will make a short stocking, which will absorb the tension from the roller, causing the long (uneven) stockings to hang limp on the machine and be unable to knock over clear. This produces sleaziness and an unsightly appearance, whereas an even set all receiving the same "pull" will be clear and beautiful, as are the good parts of the fabric in these hose.

A good way to decide whether the trouble is with the silk or the machine is to notice a loose and a tight hose, change the silk across, and see whether the loose hose is still loose with the tight silk, and vice versa. We very much doubt that the trouble is caused by the silk itself, it appearing to be almost entirely due to uneven knitting and dryness of the silk.

LATCH NEEDLE SLOTS CLOGGED WITH LINT

Technical Editor:

Enclosed find several samples of trouble we have recently encountered with the latches on our knitting needles. The slots seem to collect a substance of some nature which does not work out, causing the latches to become stiff. We manufacture men's cotton sweater coats in heather colors, backwinding our yarn using paraffiners made of 128 to 130 fine. We cannot, however, locate our trouble which seems to be general, and we are asking your assistance in the matter. (6697)

There are not enough needles here to experiment with, but we believe it may be possible to blow out this collection of lint from the back of the needle with an air pressure of around 50 to 60 lbs. per square inch and a fine nozzle. Adjusting the dial in relation to the cylinder to a position where the yarn slips off the cheek of the needle before the latch starts to close may help. This has a tendency to take loose fibers away from the latch before it closes on them. Guides which are too low would also cause trouble of this kind. It is sometimes well to run the yarn with as much tension as possible before it passes to the needles.

RAYON

KEEPING RAYON WASTE AT A MINIMUM

By H. S. E.

A group of business men and textile operating executives were discussing the failure of an acquaintance who made a line which included considerable quantities of rayon. The unanimous opinion of these men was that the failure had been largely due to waste.

Of the several types of rayon waste, perhaps the most common are as follows: (a) Skein waste at initial handling and winding of skeins; (b) spool or bobbin waste at winding or through handling at a subsequent process; (c) quilling waste; (d) twisting waste; (e) warping waste; and (f) weaving waste.

The following simple operation in arithmetic will give a figure indicating the loss due to waste: Add to the original cost of the rayon that is now waste the manufacturing cost of processing to where the waste was made plus a proportionate share of the overhead; subtract from this sum the price obtained for the waste; the remainder equals the loss due to waste.

Waste in Winding

The waste from manipulation of the skeins in winding or pooling is perhaps familiar to all who handle rayon in this form. One operation in skein winding which will often cause a considerable amount of waste to be made is the improper filling of the spools. Improper filling may occur either from the traverse not being adjusted correctly, or from the spools being filled too full. In the latter event, the slightest untoward handling of the spools will cause the smooth coils to slide over the spool edge and ravel. Obviously, when the raveled portion is removed more or less of the material is pulled into waste.

Where rayon is ply twisted on twisters which have the regulation bobbin, waste in profusion results from careless or ignorant handling of the bobbins. These bobbins are usually of the warp-wind type, either with or without the receding taper top. The receding-taper top seems to have a strong hold with American builders, whereas the warp-wind type wherein the rail traverse continues the full length of the bobbin traverse throughout the building or filling of the bobbin seems quite popular with English builders.

In the former design the layers of material are wound successively shorter in length at the upper or nose of the bobbin, the first layer going the full length of the bobbin barrel as shown at *A* in Fig. 1. The second layer is just a fraction short of the length of the first layer, the diminishing effect taking place at *B*. The successive layers then follow with similar curtailment, until the last layer of the full bobbin just reaches the point indicated by *F*.

Owing to the slippery nature of rayon it does not take much rough handling or a large maladjustment of the traverse rail to cause an entanglement at the nose of the bobbin. Once the raveling starts there is always a possibility of the whole bobbin going into waste, because when the layers at *A*, *B*, and *C* go, other than the procedure outlined below, there is generally little that can be done to save the bobbin.

Let it be assumed that layers *A* to *F* are raveled. Ordinarily, the worker will put the bobbin in the machine and try to run it off as best it will go. When this procedure is followed the rayon almost invariably becomes hopelessly tangled. Occasionally the worker will lose patience with the bobbin, and will give a tug at the raveled part. This causes the whole nose to become tangled, thus rendering the bobbin fit only to be cut off. Where bobbins contain from three to eight ounces of rayon it does not take many such raveled bobbins to make a pound of waste.

The proper thing to do when raveling occurs is a simple but very effective procedure. Just grasp the tangled parts carefully with the fingers of one hand and pull the ends taut. Cut through the part farthest from the bobbin, then tie the two sundered groups together in a firm, compact knot that will lie close to the bobbin. The portion from *D* to *F* can then be run off sideways without trouble; after this, by skillful manipulation of the raveled part, a goodly quantity of the layers *A*, *B*, and *C* can be saved.

A successful waste reducer in the receding type of bobbin under discussion is a long taper at the nose. It is true that a long taper causes a curtailment of the amount of rayon that can be wound on a bobbin, but surely no one would be so penny wise and pound foolish as to fill bags of waste for the sake of a little greater bobbin yardage.

Fig. 2 depicts a bobbin with a short, stubby, somewhat

rounded nose. With this type of bobbin, centrifugal force alone will often cause the slippery rayon yarn to ravel at the nose in such a fashion that not even an expert bobbin fixer can do anything with it.

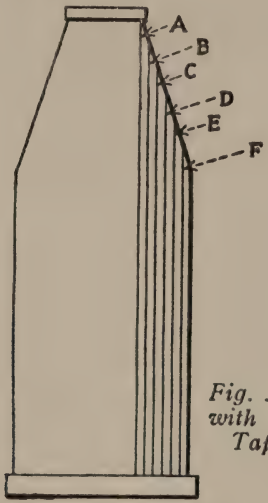


Fig. 1. Bobbin with Receding Taper Top

Let it be assumed that a set of bobbins of this form is wound and that the frame is ready to doff. So smooth is rayon that the slightest undue movement of the worker's fingers when doffing frequently will cause a shelling at the nose. Even if the bobbins are fortunate enough to escape damage in this doffing operation, the subsequent transportation and handling will eventually cause many of them to become tangled. A good rule to follow, therefore, is, "Make a long taper and save waste, time, and money."

There are times when the operator of the frame will find an outside layer of defective yarn on a bobbin or bobbins. A quick way of removing this layer is to wrap the end around a revolving spindle and let the spindle run off the yarn. This is an old cotton and wool trick, and while it works splendidly with these two fibers, it is not always so successful in rayon because of the sleekness of the latter. Consequently, before the operator is aware of it, a part of the nose sloughs off, thus causing several ounces of waste. If, however, there is little or no danger of sloughing, the spindle method is advisable.

The waste-making evil of the receding-taper-top bobbin

is practically eliminated in that type of warp-wind build, where each yarn layer, *A, B, C,* etc. (Fig. 3), runs to the top and bottom of the bobbin. In this bobbin the taper or rounding effect at the nose is accomplished by the shape of the heart-cam, which causes the traverse rail to move faster as it approaches and recedes from the top of the bobbin than when it is at the lower part. Suppose, now, that there is a slight raveling due to mishandling of the nose of bobbin. On account of the outer layer running right up to the top, this layer is often the only one that needs to be removed. Consequently, the extent of the waste is greatly reduced. Moreover, any novice can soon learn to work off the outer layer of this type of bobbin; whereas, it takes considerable time and practice for a worker to become expert in manip-

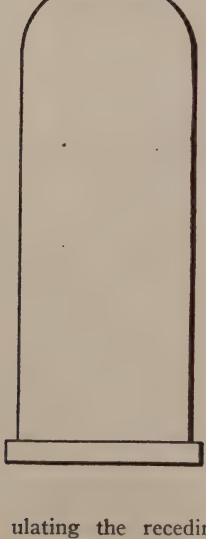


Fig. 2. Bobbin with Short Stubby Nose

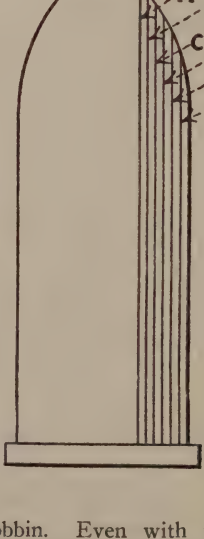


Fig. 3. Bobbin with Rounding-Taper Top

ulating the receding-taper type of bobbin. Even with this advantage, the full-length-traverse type must have a longer taper for rayon than is necessary, or even advisable, for cotton or wool.

Cheeses and cones need careful handling to prevent undue waste. Owing to the smoothness of the rayon, ruffling and consequently tangling of the outer layers of the cheeses and cones is easily done. Care must also be exercised when

fixing the raveled surfaces once they get tangled, since otherwise a considerable amount of waste may be pulled off. A simple method that is efficacious in most cases is to slide a pair of keen-cutting scissors along the outer layer, trimming across the whole length of the cheese. This obviates the pulling process or the lengthy over-end finger movement ordinarily used in removing the matted portion.

Weave-room waste is often augmented in a marked degree by thoughtless handling of rayon quills. Dumping the quills into boxes or other containers causes the lively rayon yarn to shell automatically over the top, and in a short time dozens of quills have their ends snarled and matted together. By the time the quills are made ready for use in the loom, a batch of waste has resulted. Even careful packing in boxes or other containers does not always obviate shelling of the coils. The reason, of course, is the lively nature of rayon. One way of reducing the waste from this source is to use small pin boards which hold each individual quill or pirn in an upright position with sufficient room between the quills to eliminate rubbing together and shuffling of the coils.

Waste in Quilling

In the quilling as in the twisting, it sometimes pays to have the workers lock the loose end so that it cannot uncoil

A-1

R and R Rayon Mills
Weekly Waste

Week of .....

Name	Waste	Cotton Bands	Rayon Returned	Total Returned By Worker	Original Amount Delivered To Worker	Remarks

Fig. 4. Weekly Waste Report

A-2

R and R Rayon Mills
Daily Waste

Week of .....

Name	Mon.	Tue.	Wed	Thur.	Fri.	Sat.	Total

Fig. 5. Daily Waste Record

and tangle. Locking is done by putting the loose end under one of the last coils. This precaution will suffice in most

cases where there is not excessive handling, and it is well worth trying.

When sections are large and workers comparatively green, it is a good plan to select one worker who is an expert in straightening tangled units (spools, bobbins, quills, cheeses, cones, etc.), to go around and teach the other, less experienced workers. Such a worker need not put her whole time into this job, but perhaps will work at it an hour or two in the morning, and the same length of time in the afternoon, until the whole section of girls is able to handle involved units in the proper way.

Of importance in reducing waste is some system of checking up on the waste. Nothing elaborate, expensive, or time-consuming is necessary. A form for recording waste that is in actual use in a progressive and paying mill is shown in Fig. 4.

If the waste is collected daily—and this is a good practice to discover whether any worker is maltreating the units and thus making waste—a daily record of the weight should be kept (Fig. 5). The figures from this sheet can then be transferred to the weekly sheet.

This procedure will check waste almost immediately; it will also give impetus to better care in the handling of the units, because it is obvious that an investigation will follow where a worker has double and treble the waste that a fellow worker has for the same quantity of material delivered. A few well-conducted tests will also give a fair idea of what may be considered a legitimate amount of waste for a certain weight of material produced.

When a company inaugurates this system of following up its waste, tact and diplomacy must be exercised at its introduction. Results then will be immediate and gratifying. It is a practical, scientific and economical way of handling the waste problem. It is, moreover, a versatile system, which with suitable variations can be applied to any process in rayon working.

IDENTIFICATION OF RAYON

(The Bureau of Standards has issued a proposed method for the identification of rayons. This method is presented herewith.)

The terms "rayon" is here applied to any one of several species of synthetic fibers.

Two general classes of rayons are being manufactured, namely, rayons composed of cellulose acetate and rayons composed of cellulose. The second class includes cuprammonium, nitrocellulose, and viscose rayons; these are cellulose which

has been regenerated from a cuprammonium solution of cellulose, nitrocellulose, and viscose, respectively.

Rayons differ in their physical as well as their chemical properties and it is, therefore, important that the user be able to identify the several types. This is not always easy since the same type made by different manufacturers frequently has somewhat varied properties. The following scheme is based on the quickest, simplest, and most reliable methods which have been proposed. It has been found satisfactory for the identification of the rayons manufactured up to and at the present time. It can readily be extended to include other types of rayons whenever they come on the market.

Procedure

The rayon to be tested is freed from oils and other finishing materials by rinsing in (a) boiling water, (b) denatured alcohol, and (c) ethyl ether. It is then allowed to dry at room temperature.

Cellulose-acetate rayon is distinguished from the regenerated cellulose rayons by its solubility in pure acetone or in glacial acetic acid, if acetone is not available. A small sample of cellulose acetate rayon will dissolve completely in a few minutes; the cellulose rayons are insoluble. The result of this test can be confirmed by twisting the fibers to a tight wad and cautiously applying the flame of a lighted match. Cellulose acetate rayon fuses and burns more slowly than other types and hardens at once into a brittle substance globular in appearance. Other types burn like cotton; that is, with cotton odor and leaving very little ash.

Nitro-cellulose rayon is determined as follows: If the rayon is not cellulose acetate, moisten it with a one per cent solution of diphenylamine in a mixture of two parts of concentrated sulphuric acid and one part of glacial acetic acid. (This mixture of acids is recommended instead of sulphuric acid alone as it does not dissolve rayon so quickly and the color persists longer.) Nitro-cellulose rayon assumes a deep blue color immediately and the fibers dissolve rapidly to a blue solution. Viscose and cuprammonium rayons are not colored blue and dissolve more slowly. Note: Reinthaler has recommended the following modification of this method for the identification of nitro-cellulose rayon which has been dyed with dark colors: "The rayon (0.5 gram) to be tested is dissolved as far as possible by stirring with a glass rod in a test tube containing 10 c.c. of a mixture of equal parts by volume of concentrated sulphuric acid and water. After five minutes the mixture is poured into a 100 c.c. flask with a long thin neck, e.g., a measuring flask. A glass filtering crucible, whose porous glass has been impregnated with a few drops of diphenylamine reagent (see above) by means

of a glass rod, is inverted over the mouth of the flask. The flask is then suitably supported and very slowly and carefully heated with a small naked flame, keeping the contents in gentle motion. First the fibrous residue dissolves, the solution becomes paler, then darker again, and finally black. In case of cellulose-nitrate rayon, the bed of the crucible is usually colored blue by the nitrogen peroxide formed, before a considerable evolution of gas occurs. After about five minutes, i.e., ten minutes after beginning of the test, the liquid froths considerably and the blue color disappears, being replaced by the yellowish-brown color of deposited tar."

Viscose rayon is determined in the following manner: If the rayon is neither cellulose-acetate nor nitro-cellulose rayon, it is tested for sulphide sulphur. A special test tube of the construction shown in the following outline drawing is convenient for this test. Introduce 0.2-0.3 gram of the rayon into the test tube and add 10 c.c. of a 3% sulphuric acid solution. A piece of filter paper soaked in a 10% lead acetate solution is placed over the opening of the tube and is held in position by means of the cap. The tube is immersed to a depth of about four inches in a steam bath and heated for four hours. If at the end of this period the exposed part of the lead acetate paper becomes stained with a brown or black color (indicating the presence of sulphide sulphur), the sample is viscose rayon. Cuprammonium rayon gives a negative test.

This test will give erroneous results if the rayon has been dyed with sulphur colors. Cross sections of such rayon will have to be prepared and examined microscopically. The presence of dark striations indicates viscose rayon. Cuprammonium rayon does not exhibit dark striations in cross section.

Cuprammonium rayon is determined by elimination. If the

Key to the Identification of Rayons

Remove finishing materials by rinsing sample in boiling water, alcohol, and ether.

Treat small sample with acetone (or glacial acetic acid).

Sample dissolves: Cellulose-acetate rayon is present.	Sample does not dissolve: Cellulose-acetate rayon is absent.

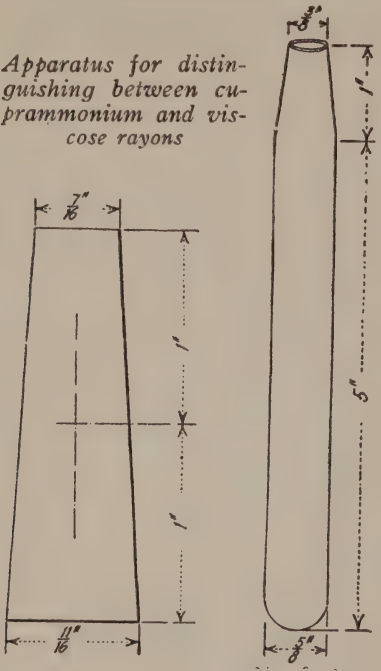
Moisten fresh sample with a one per cent solution of diphenylamine in two parts of concentrated sulphuric acid and one part of glacial acetic acid.

Sample turns blue: Nitrocellulose is present.	Sample does not turn blue: Nitro-cellulose rayon is absent.

Test fresh sample for sulphide sulphur.

Sulphide sulphur is present: Viscose rayon is is present.	Sulphide sulphur is absent. Cuprammonium rayon is present.

Apparatus for distinguishing between cuprammonium and viscose rayons



Full Size *Half Size*

rayon is not cellulose acetate or nitrocellulose, and gives a negative test for sulphide sulphur, that is, no coloration of lead acetate paper in the test given above, then the sample is cuprammonium rayon.

Brands of Rayon

A list of the various brands of rayon classified according to the method of manufacture are as follows:

1. *Cellulose-acetate rayon.* Celanese, Chatillon, Lustron, Rhodiaseta.
2. *Cuprammonium rayon.* Bemberg, Napon, Zelloag.
3. *Nitro-cellulose rayon.* Chacelon, Chardonize, Tubize.
4. *Viscose rayon.* Acme, Belamose, Celta, Chatillon, Cisa, Crown, Delray, Discrella, Dulenza, Lulesco, DuPont, DuPont Super-Extra, Enka, French Viscose (VVS), Glanzstoff, Kasema, Lolustra, New Bedford, Premier, Shenandoa, Snia Viscosa, Zehlendorf.

PREVENTING CHAFING OF RAYON YARN

By Periodically Inspecting and Recording Condition of Guides

By H. S. E.

A rupture of some of the fine filaments of which a rayon thread is composed will cause a whiskery, fibrous appearance of the finished product—a condition that materially impairs its quality. In the case of yarns plied for sewing, etc., as a substitute for silk, the chafed portions are particularly undesirable in that they weaken the thread.

These broken filaments are brought about chiefly through contact with rough, sharp, or channeled surfaces whose cuts are smaller than the diameter of the denier being run. Especially is the foregoing true when there is also the accompanying fault of too much tension, which itself is often heightened by too great an angle for the yarn, and a high speed.

Fig. 1. Channeled Yarn Guide

Fig. 1 shows a common guide with a channel cut at the part *c* where the yarn makes contact with it. It will be readily understood that the material is going to be damaged if it is forced to run along the channel made by a finer denier.

Periodic Inspection

To eliminate such cuts or channels, or other faulty conditions of guides, rods, and other surfaces, it is essential that a rigid scrutiny of each guide and bearing surface with which the rayon comes in contact be made periodically. The periods should be frequent enough to prevent any damage to the goods taking place between inspections. Tabulating the results of inspections made at close periods will soon give a fairly good idea of the frequency required.

In addition to the periodic going-over, there should also be a special inspection when changing from one denier to another, especially where the change is to a radically coarser count.

When ply yarns are twisted on machines using rings and

travelers that are common to cotton and wool, great care must be exercised to see that the travelers are changed frequently to avoid cuts. Also when changing from a certain denier to one slightly heavier—a move sometimes made without changing travelers, as a matter of economy—care must be taken to see that the travelers are not so old that they have become channeled. Such travelers tend to fray the yarn.

Rings Must Be Burnished

Moreover, in this type of twister it is essential that the rings be kept well burnished, since any corrosion will help to retard the traveler at starting time, morning and noon. This causes stretching and may result in partial rupture of the strand, occasionally even causing complete rupture.

"It Pays to Scrutinize"

Compensator guides, subject as they are to innumerable strains and jerks, should be closely watched and renewed when showing signs of cuts. Indeed, every wire, rod, guide, or surface, of whatever material, over which the rayon runs should come in for the suggested periodic scrutiny. "It pays to scrutinize" would make a good slogan for concerns working on rayon.

While it is usually advisable to renew guides, etc., when cut, there are sometimes occasions when, for reasons of economy, the same units—if of metal—may be put into good shape again if the indentation is slight. Fine emery cloth and oil, with a finishing touch of leather, will do a good job. Obviously only a trusted person should be given the work of using the emery cloth, since a careless person can make a bad matter worse by leaving emery scratches.

Rods and wires may sometimes be advantageously turned or moved laterally so as to present a fresh surface to the rayon. This is a good stunt to carry out where practical, as it saves the cost of renewal. Another worth-while pointer in working rayon is not to renew a wire or guide here and there on a side, but rather to renew one whole side or machine and then to use the best of the left-overs for renewals on other machines. Records of renewals will be more easily kept track of in this fashion and the danger of uneven wearing escaping attention and causing damage will be materially lessened.

Overseer's Book

Experience in other textile fibers has taught that it is not good management to leave the matter of following up and changing the nicked guides and rods entirely to the section-hand. The overseer should have a special loose-leaf sheet

or a book ruled to cover each machine in each section-hand's place, and this book should be turned in to the overseer's office weekly or monthly, as the arrangement may be, so that he can keep tabs on what is going on. A permanent record which can be referred to in the future is thus assured, and a handy thing it will prove to be.

Fig. 2 shows a record sheet that has given good service and will be found efficacious by any firm that wishes to try it—the understanding being of course that it is flexible and that any changes or interpolations may be resorted to which will in any way serve to make the inspection more effective.

Where the span of time for inspection stretches to something like two or three months, it is a good plan—if the section-hand does the examining—to do a few frames weekly, rather than to lump the work, since the latter procedure throws too much work on the section-hand at one time, with the consequent possibility of his slighting the inspection because of lack of adequate time.

It is better to do it as follows: Assume that there are 48 machines on a section and that there is a tri-monthly inspection period. This would be about four machines per week, and these four could be spread out over the week; i.e., one Monday, one Tuesday, and so on. By working in this way, the time required for looking over the guides and rods is comparatively small daily, and the inspection is always in mind. Furthermore, it obviates the chance of having all the surfaces going bad at one time.

RAYON WEAVING SUGGESTIONS

Practical Advice on Rayon Yarns and Loom Operation

By Ray Winder

There is little, if any, profit in using inferior grades of rayon. The writer has had under his direction a set of automatic looms weaving a fancy pattern and laid out for sixteen looms per weaver. When we used an inferior grade of rayon the best we could get was a production efficiency of 65 per cent. Much difficulty was experienced due to filling breakage; the cloth woven was of an inferior grade due to shiners, sluff-offs, and broken patterns. After taking the matter up with the management, permission was granted to use an "A" grade rayon. Without any loomfixing or other alterations, one weaver was able to handle the job and give us first-quality cloth with a weaving efficiency of 85 per cent. A loom has its limitations and cannot improve the quality of a yarn.

Wood temple rolls with steel prongs often cut rayon filling during the process of weaving. A rubber temple roll has been perfected which has helped to overcome this trouble. In some mills there has been a belief that the winding of rayon under the same humidity as it was to be woven under was of great benefit. But experience has taught us that the same results can be obtained without going to such extremes. It is now generally known that rayon should be handled as little as possible before it is woven into the cloth. Every time the yarn is wound from one package to another, a strain is placed upon the several filaments, which are sometimes broken. Strains also produce shiners.

One of the things needed at present is a loom with a shedding mechanism that can be operated while the loom lay is stopped for the purpose of finding the pick. Such a mechanism is already in use on the pick-and-pick looms used in the woolen and worsted industry. At first it would seem that the cost of such a mechanism would be prohibitive, but as rayon has come to stay we should have machinery that is adapted to produce a fabric free from defects.

It has been the writer's experience that a loom equipped with a high roll (not an intermediate roll) take-up motion will give the best results. Another experience of the writer's has been rather a departure from the ordinary practice of using a friction let-off on rayon warps and cotton-warp, rayon-filled goods. We have made excellent fabrics by using the automatic gear let-off on all classes of goods from fine denier voiles to heavy alpacas and eight-harness sateens. In every instance the gear let-off has given the more satisfactory results. This in view of the fact that the friction let-off, which is widely used in the manufacture of real silks, has always been considered the ideal motion for the manufacture of fine goods.

After trying nearly every type of shuttle for the handling of the filling, we have concluded that any type which suits the maker's fancy is satisfactory. By placing a proper tension or friction in a shuttle, any of them can be made to give satisfactory results, provided the speed of the loom is not too great. A speed of over 140 r.p.m. is not recommended for the best results. At present the writer has charge of looms running 170 picks per minute, which produce good cloth. However, when an end breaks it requires more time to bring the loom to a stop than one running at 140 picks per minute, even though its brakes are in first-class condition. The same law applies to speeding looms and shuttles as to speeding automobiles. Lower speeds will give the more satisfactory results in the manufacture of rayon or other fabrics.

MANUFACTURE OF RAYON VOILE TWIST

By H. S. E.

Voile twist is a single yarn produced for weaving rayon voiles. The growing popularity of rayon voile has led to an ever-increasing range of deniers in its make-up, running from 35 deniers to 150 and coarser. The twist ranges from 30 to 50 turns per inch. The 75-denier material, which is the basis of this article, has been in considerable demand, both for dress and drapery purposes. Warp and filling are generally alike, with a twist of about 30 turns. A flow sheet of the various processes is shown in Fig. 1.

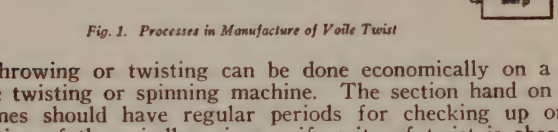


Fig. 1. Processes in Manufacture of Voile Twist

Throwing or twisting can be done economically on a first-time twisting or spinning machine. The section hand on these frames should have regular periods for checking up on the friction of the spindles, since uniformity of twist is absolutely requisite to a perfect product. On the twisting machine, as in every other process where rayon is handled or worked, it is of prime importance that no undue strain or chafing be imposed upon the yarn. Especially true is this in voile twist. Yet, unless constant care is exercised, it will be found that the guide wires will get out of alignment for various reasons, and the yarn will rub on the edge of the spools. This action, which is illustrated in Fig. 2, is apt to break the delicate filaments and cause a deterioration.

The spindle speed is a matter for individual judgment, but 8,000 r.p.m. is a good figure to start from. Should the ballooning prove excessive, a set of ordinary separators can be fitted to the machine if not already on. Or, if the twist is high, approaching that of crepe, the regulation flyer tension may be used.

As it is essential to set the twist, the yarn is wound on special conditioning spools, wooden-barreled, metal-flanged, perforated at barrel and ends. The perforations facilitate entrance of the steam allowing penetration from the center of the spools as well as from the outside. The length of time that the material is kept in the steam chest depends upon the amount of twist inserted; the greater the twist, the longer the steaming. About four minutes for 30 turns, and six minutes for 50 to 60 turns should be nearly right. However,

a little experimentation will soon show what is right for the individual mill.

To do a good job, with the least handling, the conditioning spools are placed on metal pin-boards and packed into a specially designed steam-chest truck. It is advisable to have the chest floor even with the mill floor so that the truck can be pushed in and out of the chest on a level, so that one man can handle the exit and entrance of the truck quite readily.

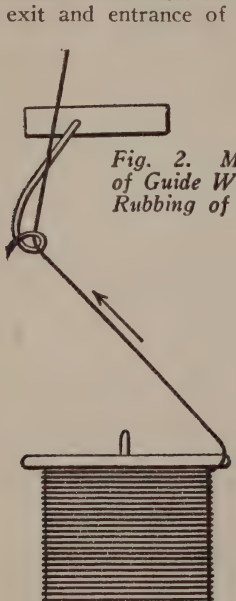


Fig. 2. Misalignment of Guide Wire Causing Rubbing of Yarn.

Translated into cost-control terms this means that one man is being paid for this job, instead of one and a fraction men.

From the steam chest, the material is taken to the re-draw frames, where it is converted to the regular spools again. It will pay to have the re-draw frames equipped with pin-board holders, so that the yarn boy can place the full boards directly on the machine. The worker thus does not have her attention diverted from her machine by the need of chasing after the material. By permitting her to give undivided atten-

tion to the machine, the operator will increase her production and improve the quality.

After re-drawing, the yarn is made into filling and warp. Since the deleterious effects of strains and abrasion are more or less familiar now to users of rayon, it seems almost superfluous to stress the need of alertness to prevent undue stretching and scraping of the yarn. Every surface over which the material passes should be closely scrutinized at regular intervals by the section-hand, and all cut or rough places eliminated, either through smoothing where this is practical, or by the replacement of the faulty part.

The overhead hanger which leaks is still too prevalent a cause of soiled goods to be passed over without a few remarks. Oil dripping on goods, whether in yarn or cloth form, is bad for cotton, wool, or silk; but it is far worse for rayon. It would, indeed, be interesting to have accurate statistics showing the losses the textile industry sustains on account of the oil drop from above.

Various schemes are tried to overcome the trouble. One firm, which insists on meticulously clean products from its machinery, has fitted the outlet of its overhead hangers with small pail-like tins which can be emptied from time to time. Another concern is experimenting with a shallow pan running the full length of the bearings.

Mauling the yarn with dirty hands is another evil that helps make life for the operating executives just a ceaseless stream of worries. Only a strict insistence on care in the handling of the yarn, whether in skeins, or on spools, will reduce this fault to a minimum. And rayon voile twist that is to make perfect voile cloth must be free from oil stains and soiled spots.

CUT FILLING IN RAYON CREPE DE CHINE

Technical Editor:

Kindly note that one of our customers is having considerable trouble with rayon crepe in the finished goods. We do not know whether the trouble lies in the raw silk, in the throwing, weaving, or dyeing. We are sending you a sample showing the trouble after the goods have been finished. The spots only run along in sections for about one-half yard at a time. Out of 100 pieces sent to the dyer, 30 or 40 of them will come back in this condition. The goods appear to be perfect in the gray, and this trouble only shows up after the cloth has been dyed. You will note that this is made from 100 denier yarn.

(6897)

Ans.—The fabric submitted is an all-rayon crepe de chine, and appears to have been made with 90 ends per inch in the warp of regular twist rayon yarn, reeded 45/2, and to have

been woven with 60 picks of crepe twist rayon filling, two right-hand twist and two left-hand twist picks alternately, in the usual manner.

Scattered quite freely over the face of the cloth are shiny, horizontal marks, varying in width from $\frac{1}{8}$ in. (occasionally even less) up to $\frac{1}{2}$ in. in length, or even more. most of them being between $\frac{3}{16}$ and $\frac{5}{16}$ of an inch long. On examining these places under magnification against the light, it will be observed that the picks are missing in these spots, and the slacker twisted warp threads thus extend unbound over a space of three picks. These show up as shiny lines on the surface. This, in my opinion, is due to the cutting of the fibers of the filling threads on the sand roller of the loom.

Rayon warps are usually woven with very heavy tension on the warp beam, and, if the sandpaper on the take-up roller is unduly sharp, the points of sand cut into the fabric with a chisel-like effect. This has a more severe action upon the filling threads than upon the warp threads, for the action of the sharp points of the sand against the former comes at right angles, whereas against the latter it is lengthwise. During the weaving, the filling threads may from this influence become completely severed, partly cut through, or simply slightly frayed.

It is easy to understand why this is not observed in the gray goods, but if the gray cloth was drawn down over a perch and the examiner should look through the cloth against a strong light, searching for such places in the threads as were completely cut through, some of them could doubtless be discovered in this way. Without such a careful and meticulous search, they would not attract attention.

In the course of the finishing operations, the fabric comes to the tentering frame, and in a damp condition is strongly stretched out sidewise. In the damp condition the strength of the rayon will probably be diminished to about half its dry strength. The filling threads, thus diminished in strength, in the places where they have been weakened by the fraying or cutting, will break apart, and, as rayon contracts very much when wet or damp, the ends of the yarn, where cut, draw away from each other and leave the gaps referred to. Some portions of the yarn, owing to local variations in the amount of twist, etc., and owing to the greater or less closeness with which the warp threads grip the filling at these places, will shrink apart more or less actively.

If the ends of the broken threads at these cut places be examined, it will be seen that where the gap is a short one, say $\frac{1}{8}$ in., the filling threads will lie quite smoothly up to the point of breakage. Where the gaps are longer, the ends of the threads will be found to be very much crinkled up. If these crinkled-up threads are taken by the ends with a pair of forceps, and the ends drawn together, it will be found that,

without puckering the fabric, they can be brought home to their original positions. In some of these defects, particularly in the extra long ones, the break is intermittent, a small portion of the filling thread remaining intact in the center of the cross lines, thus showing that the cutting has taken place on two parts of the same thread very close to each other.

An examination of the damaged places also shows that the warp threads at these spots have been substantially frayed, many of the fibers being cut. As the pull of the cloth lengthwise in the tentering frame is much less than it is fillingwise, and as the proportion of the warp fibers that are cut is much smaller than in the case of the filling yarns, no severance of the complete warp threads takes place. If the fabric is cut lengthwise and a substantial number of warp threads drawn off and examined, it will be found that in some of these the fibers here and there will be cut, although no filling threads may present the cutting effect at these places. A careful examination of the body of the cloth, under magnification, discloses many slightly frayed places where the cutting effect has not been sufficient to produce a rupture of the yarn.

You should make careful note of the piece numbers of goods which display this damage, and with this information in hand locate the particular looms that the goods were woven on. If the sand roller of a loom was too sharp, the cutting effect might naturally be expected to take place on the successive pieces woven on that loom. Other looms, on which the sandpaper was not too sharp, would produce goods free from this defect. Of course the warp tension and the cutting effect are closely interlocked. By moderating the tension on the warps, the looms on which this trouble occurred might cease to cause it, or, by increasing the tension on some loom that was not giving trouble, sand-roller cutting might be induced.

To guard against or to overcome this trouble, some manufacturers have their friction rolls covered with corrugated rubber, or with pyramid pointed rubber, which will get a good grip on the cloth but cannot scratch it.

REMOVING PARAFFIN SIZING FROM RAYON

Technical Editor:

We have recently received rayon crepe and georgette pieces in which the filling twist has been sized with a mixture containing a high percentage of paraffin wax. The method we have developed for scouring the goods has given results satisfactory to our customers, but it is expensive and does not al-

ways give the desired results, a second treatment being sometimes necessary. We are therefore applying to you for information on the scouring of pieces containing yarn sizes with paraffin, as there may be a cheaper and simpler method than the one we now use.

We were under the impression that the use of paraffin had been given up by textile manufacturers. Do you happen to know whether some new method of application has been developed lately? Do you advise our recommending the substitution of tallow for paraffin? You may be sure that any information you may give us will be greatly appreciated.

(6873)

It is believed that the wax which is causing the trouble, and which may not necessarily be paraffin wax in whole or in part, is in the crepe filling. Various wax preparations are said to be used in several ways with rayon yarns: (1) as sizing applied to warp yarns directly on the looms; (2) as sizing to filling or warp yarn in skeins or in process to facilitate winding, twisting, or warping by lubrication and protection of the yarn from abrasion damage; and (3) as a finishing size.

Successful substitution of tallow, Japan wax, or other "sponifiable" or emulsifiable wax for the paraffin wax might depend upon the purpose intended, and whether or not the size is a purchased or a "homemade" preparation.

Waxes may often be removed by emulsification or solvent processes, the severity of the conditions of which (as to temperature, time, alkalinity, and mechanical working of the goods) depends upon the state of manufacture, whether in the gray or dyed, and subject to alteration in shade.

Scouring methods may include: (1) Dry cleaning with warm organic solvents, like naphtha, or mixtures of naphtha with carbontetrachloride, in safe apparatus. (2) Scouring in strong soap solutions in soft water, using mild alkalies like sodium phosphate, with or without wetting-out agents. (3) Using mixtures of soluble or sulphonated oils and organic solvents, like xylol, naphtha, carbontetrachloride, in conjunction with additional soap or alkali, if necessary. (4) Applying special emulsifying soaps made up from oleic acid by partial saponification with caustic soda after admixture with emulsifying agents like tetralin, methyl hexalin, or more recent products of similar nature, or soluble oils.

Time and expense may often be saved in scouring goods containing wax by drying a small test swatch and comparing its water absorbing capacity with that of satisfactorily scoured material, before removal of the remainder of the material from the apparatus and before the dumping of the scouring bath. If the swatch gives unsatisfactory results, a longer scour in the same bath may then be given without further interruption.

SETTING TWIST IN RAYON

Technical Editor:

We would like to have information on proper conditions to set twist in viscose rayon, especially in regard to time, temperature, and humidity. Any information on methods of setting twist, or suggestions on where to obtain this information would be welcome. (6725)

Due to the natural characteristics of the regenerated rayons —viscose, nitrocellulose (Tubize), and cuprammonium (Bemberg)—we do not believe it is necessary to condition the yarn to set the twist, provided atmospheric conditions are under automatic control and maintained at about 75° F. and 65% relative humidity. However, we submitted the inquiry to a large rayon user and he replies as follows:

The usual procedure where rayon is conditioned is to put the spools of yarn, after twisting, on pin boards and slide the latter into trucks that fit into a steam chest. Sometimes the chest is fitted with slides and the boards are slipped on these and into the chest.

The length of time the yarn is in the chest depends upon the individual case, and each mill must work this out for itself. Good results are being obtained by steaming for about 5 min. This is for a twist of 30 to 40 turns per inch or more, and using 60- to 100-denier rayon.

Since the chest is full of steam during the process of twist setting, the humidity is practically 100%. The temperature may run up to about 180° F.

THE KNOT NOBODY KNOWS*

Reasons for Superiority of Weaver's Knot Over All Others—Two Methods of Tying It by Hand, Difference in Resulting Knots, and Why One Is Better—Difficulties in Teaching Operatives—Should We Consider Direction in Which Yarn Runs?—Mechanical Knotters

BY EDWIN D. FOWLE
(Illustrations by the author)

Any statement to the effect that the weaver's knot is a knot nobody knows will be recognized, of course, as an obvious hyperbole; but it is an undeniable fact that the number of people who know how to tie this knot in comparison with the number who should be tying it constantly is regrettably unimpressive. The advantages in its use are generally understood and even the fact that it is or should be the standard knot of the textile industry is widely recognized; but its more extended adoption is still obstructed by the difficulty many find in learning to tie it, in teaching others to do so, and in becoming adept in its use. Operatives find that it causes a loss of time, that to practice tying it is a nuisance, and that no one is likely to fix the blame if they choose to employ a less difficult knot. Many an overseer finds that, after carefully instructing an operative in tying the weaver's knot, he has only to turn his back before the old knot is returned to service again.

Difficulties in Teaching

Tying two ends of yarn together in a certain way becomes, of course, a habit. To endeavor to change it is like trying to change a person's hand-writing. It would be no more difficult, probably, to teach a professional tennis player to hold his racket in an unusual manner. The operation becomes a second nature, a mechanical set of motions requiring no tax on the mentality; and any change imposes a new strain on the brain, the finger muscles, and the patience.

The usual method of learning how to tie the knot is by observation. The one who is to learn stands at the shoulder of the instructor and watches him place the ends together, swing them around into their proper relation to each other, push one end through the loop, and tug at the proper ends for tightening. The novice then endeavors to do the same; and perhaps he succeeds. In many cases, however, he pretends that he understands the procedure long before he is actually sure of it, in order not to appear too stupid to his instructor (who might very possibly be his overseer) or perhaps because he considers

*Not even Bruce Barton.

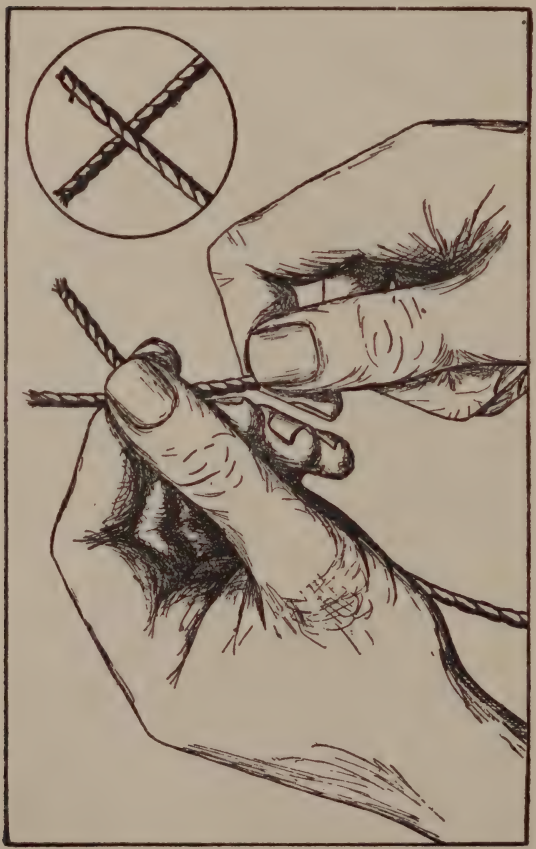


Fig. 1. Cross the Two Ends, Making Certain That the End from the Left Hand Is in Front of the End from the Right Hand

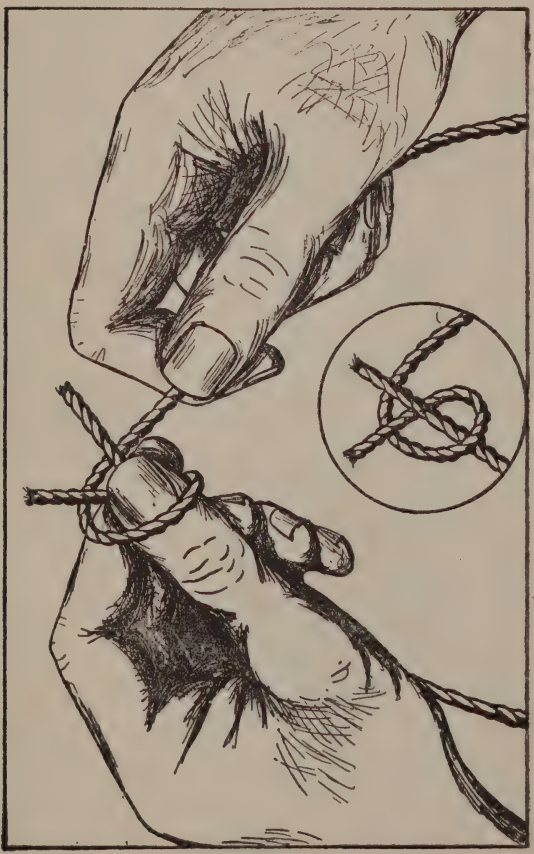


Fig. 2. Swing the Yarn in the Right Hand Over the Left Thumb and in Back of the Two Ends

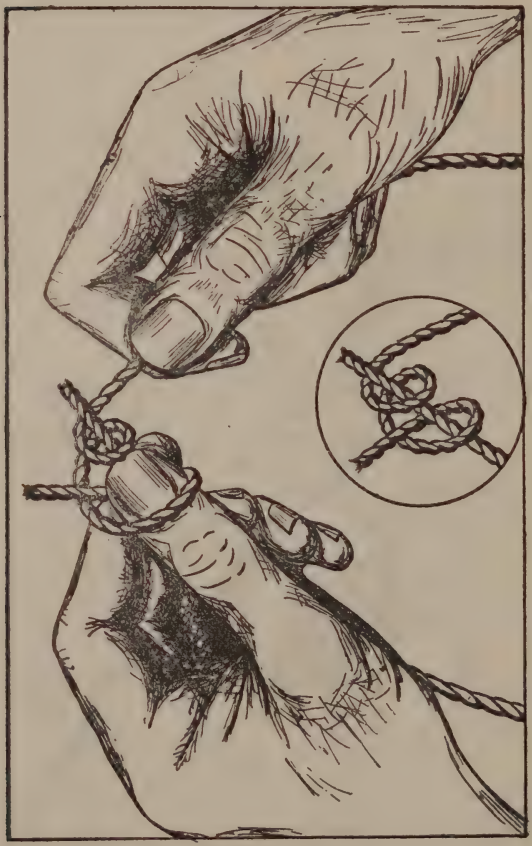


Fig. 3. Now Swing the Same Yarn Around Only the Right-Hand End

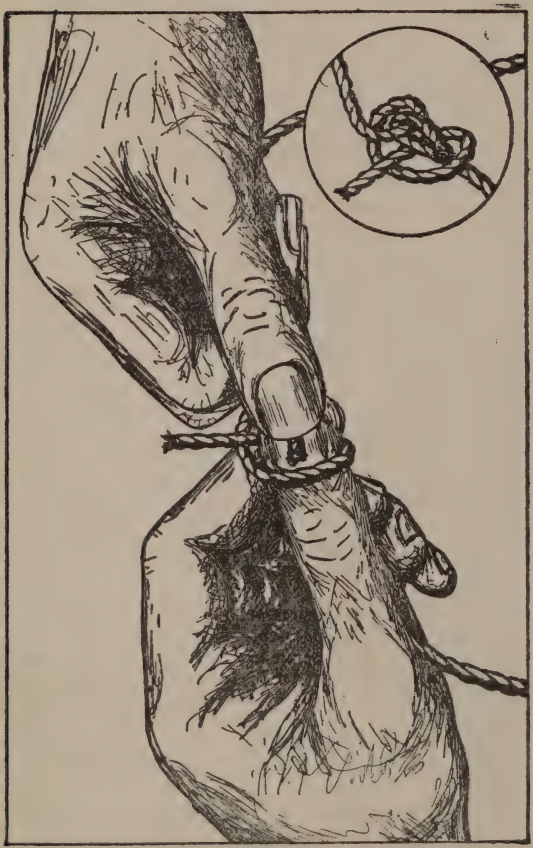


Fig. 4. Push the Right-Hand End With the Right Thumb—

it unnecessary to take up more of the instructor's time, believing that he can figure it out later for himself. Although such an operative may attempt to use the knot when he has returned to his machine, the chances are that he will soon become discouraged and dismiss the whole thing from his mind.

I recall that the gentleman who taught me how to tie the knot informed me that it had taken him a month to learn. Probably that remark was intended to encourage me, for I am sure it requires only a few minutes of concentration with the proper instruction for the idea to take hold. Unfortunately, the idea can be quickly lost after it has once been caught.

Procedure Illustrated

It occurred to the writer a short time ago that a set of pictures might be made to show each step in the process of tying the knot, thereby supplying a definite, permanent record which would enable anyone with two hands and a few fingers to learn the correct procedure. This would make possible self-instruction, allowing the beginner to concentrate on the problem at his leisure.

Each girl in a spooling department, for example, might be supplied with such a medium of instruction for her own use, or sets of the diagrams might be posted in accessible locations in the mill.

I have seen many diagrams illustrating the completed knot, but one might as well study the completed form of an axminster carpet to find out how it is made, as to learn how to tie the weaver's knot by the study of such a diagram. It is hoped that the accompanying illustrations, although crudely drawn, will supply this need.

Besides the educational purpose of this article, there are two other objects of less importance. One is to show that, of the two methods of tying the weaver's knot, one appears to be preferable to the other. Unfortunately, as in many other things, the best way is generally considered the most difficult. The other purpose is to show that it makes some difference whether the right or the left-hand side of the knot (as it is tied) is in the direction in which the yarns are to move.

How It Is Tied

Now let us give our attention to the mechanics of the knot itself. Take two pieces of yarn and cross them as shown in Fig. 1. (The circular inserts show the positions of the threads at each step.) Be sure that the yarn from the left hand crosses in front of the yarn from the right hand, as shown. Then swing the yarn in the right hand up and around in back of the two ends, as in Fig. 2. Again swing the yarn in the right hand, this time passing it up between the two ends and

Fig. 5—through the Loop Made by the Left Thumb

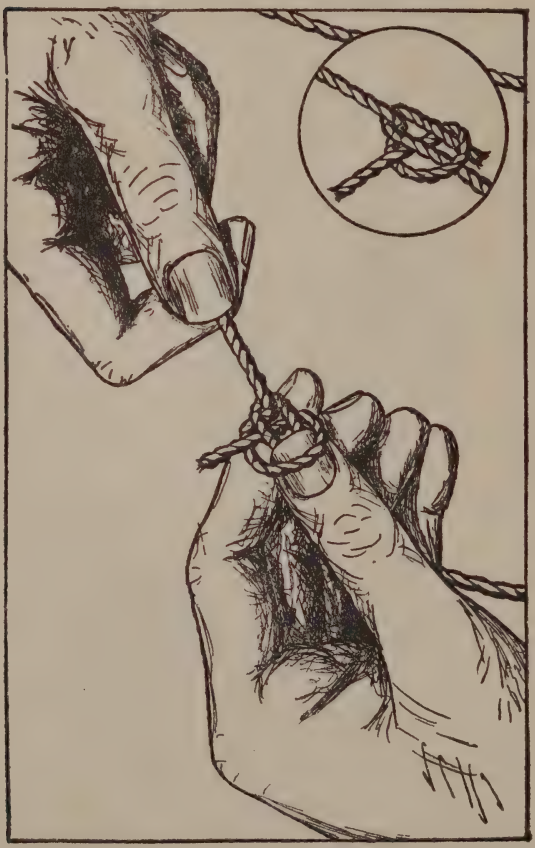


Fig. 6. Now Clamp the Left Thumb on the Yarn in the Left Hand and Pull Hard With the Right Hand

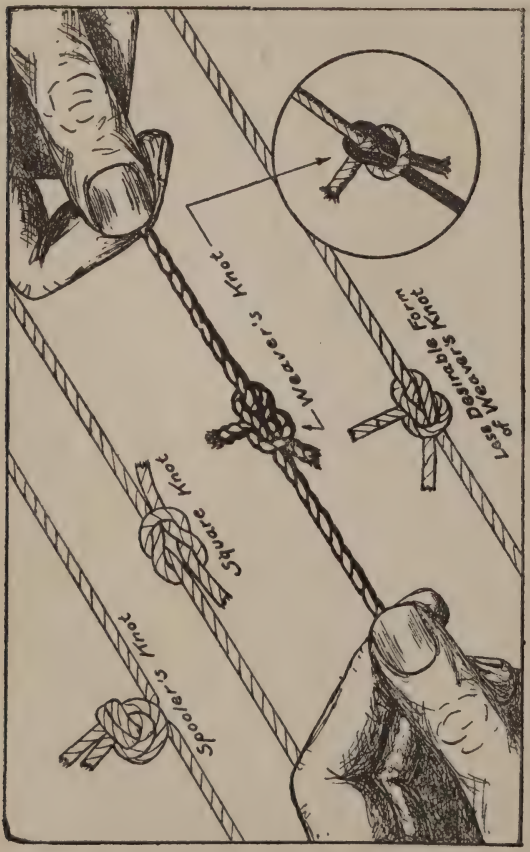


Fig. 7. The Result Is the Weaver's Knot. Other Knots Are Shown for Comparison

down in back of the right-hand end, as shown in Fig. 3. With the thumb of the right hand, push the right-hand end down through the loop formed by the yarn lying over the left thumb, as in Figs. 4 and 5. Next, grip that end with the left thumb and pull hard with the right hand, as in Fig. 6. The knot is now tied and may be released. It will then have the appearance shown in Fig. 7. This is the most desirable form of the knot, but the method of tying it is the more difficult of the two.

The other method may be studied with the aid of Fig. 8. Begin as in Fig. 1, make the second step as in Fig. 8, and then proceed exactly as in Figs. 4 to 7 inclusive. It will be noted that Fig. 8 simply takes the place of Figs. 2 and 3 in the first method. The circular inserts do not show the positions of the threads at each step in this process, except in Fig. 8. The completed knot is shown in Fig. 7, and is labeled, "Less Desirable Form of Weaver's Knot."

The difference between the two knots is not very great. In the knot made by the first method, the two short ends appear, usually, on opposite sides of the knot, and in that made by the second method they are on the same side. The first knot—theoretically, at least—more evenly distributes the interference of the ends with neighboring warp threads. It also makes it impossible for the two ends to become glued together in sizing and increases the likelihood of the knot being concealed in the woven or knitted fabric. In all other ways, the two knots are identical.

Advantages of Knot

Fig. 7 illustrates how compactly the threads are linked and how centrally the knot is located with respect to the axis of the yarn. The weaver's knot is one of the smallest known. Its size and its central position enable it to pass through heddle eyes, reed dents, and the hooks of knitting needles with a minimum of difficulty, and consequently with a minimum impairment to the quality of the finished product and a minimum loss of production. It is seldom responsible for tight picks, and its size also allows it to become buried in the completed cloth. An advantage that should be particularly emphasized is that it does not slip. As the tier becomes more experienced he is able to reduce the length of the short ends.

Possibly the only disadvantages in the use of the weaver's knot are, first, the twisting and loosening to which the yarn is subjected during tying—this disadvantage is of course most effective in tying weak yarns—and, second, the additional time required.

Direction of Motion

A close study of the knot seems to indicate that in tying it consideration should be given to the direction in which the yarn is to travel. If the knot is passed to the left through a small

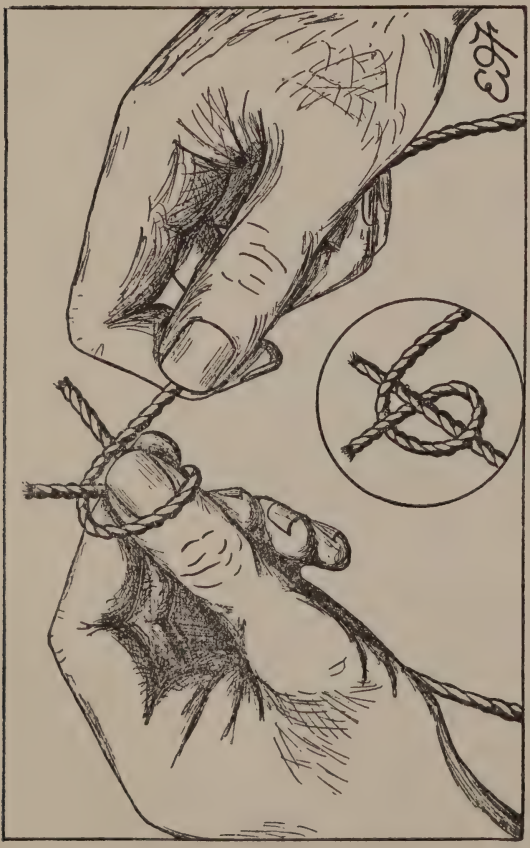


Fig. 8. The Alternative Method. Proceed as Before, Substituting This Diagram for Figs. 2 and 3

opening, it is much more likely to catch than if it is moving to the right through the opening. This is because one of the short ends projects from the left of the knot close to the long end and makes an acute angle with it, thereby offering a hook which—although somewhat flexible, of course—will tend to catch on the first obstruction. The other end of the knot seems to be built somewhat like the head of a spear, enlarging from a point to its full width at the center of the knot—an ideal arrangement, of course. The short end projects at right angles to the yarn and hence offers more flexibility, since it does not require to be bent to such an angle in slipping by obstructions. From this consideration it would seem that in preparing to tie a weaver's knot the end of yarn which lies in the direction the yarn is to travel through the loom or knitting machine should be held in the right hand.

Some who have studied the subject believe that a short end which remains close to the yarn is more advantageous than one which stands at right angles to it. This is unquestionably true in respect to the interference with neighboring warp threads, but does not hold in regard to slipping by obstructions. It should be noted that the left end of the weaver's knot is identical with either end of the so-called square or reef knot, illustrated in Fig. 7; and, if it were true that this arrangement of the ends is preferable, the square knot would be the most desirable. (The square knot is used to a considerable extent in the textile industry, and is commonly employed by the general public for tying bundles, etc. It is larger than the weaver's knot.)

There have been attempts made to develop a mechanical method of tying the weaver's knot. Most of these attempts have been unsuccessful, but there are at least two such knotters now in general use which enjoy a large popularity. One of these is a component of the automatic spooler manufactured by the Barber-Colman Co. The other is the Boyce weaver's knotter, manufactured by the Mill Devices Co., Inc.—a compact device which fits on the hand.

HUMIDITY—ITS EFFECT ON YARN AND WORKERS

Further Discussion of Relations of Temperatures, Humidities, and Rates of Air Movement to Comfort and Efficiency of Operatives, Considering Also the Most Advantageous Manufacturing Conditions—Inducing Air Movement to Supplement Cooling Effect, Especially During Summer Months

BY S. WYATT

In response to the invitation extended by A. W. Thompson in his article, "Effect of Humidity on Operative Efficiency," in

the April 23 issue, for further discussion of this topic, Mr. Wyatt has prepared the accompanying discussion. The present article is based on experiments relative to humidities, effective temperatures, air movement, etc., performed in weave sheds by both British and American investigators.

The article, "Effect of Humidity on Operative Efficiency," by A. W. Thompson, which appeared in the April 23 issue of TEXTILE WORLD, is a reasoned argument in favor of humidification by water-spray instead of steam. As a result, the use of fans for cooling purposes is believed to be unnecessary, since the same cooling effect can be obtained by the use of water-sprays.

No one, of course, will deny that humidification by steam raises the temperature of a weave shed and increases the discomfort of the operatives, while water-sprays tend to have the opposite effect. For this reason the continued use of steam for purposes of humidification in the majority of Lancashire weave sheds is difficult to understand. Presumably, humidification by steam is less troublesome and expensive than the water-spray method, and when the latter is in use the imperfect vaporization which sometimes occurs raises objections from the operatives. By giving more attention to the apparatus however, cause for such objections should be eliminated.

The validity of Mr. Thompson's assertion that "the use of independent fans may be avoided by the simple expedient of providing an ample evaporation of water" will, however, depend upon the realization of certain conditions.

Considerations Necessary

In the first place, we have to consider the most suitable atmospheric conditions from the standpoint of the yarn used in the weaving process. There is evidence to show that up to a certain definite point the number of breakages decreases; and, consequently, weaving efficiency tends to increase as the temperature and humidity rise. An investigation* in the Lancashire cotton industry showed that this point corresponded to a relative humidity of 85 to 87.5% at a temperature of 77.5° F., and a temperature of 82.5 to 85° F. at a relative humidity of 77.5%. These values refer to a particular kind of cloth and would probably be different for lighter, or for more heavily sized yarn.

Second, the most favorable atmospheric conditions from the standpoint of the operatives must be taken into consideration. Definite evidence in this connection does not appear to exist, but American ventilating engineers have found† that the maxi-

*Report No. 37 of the Industrial Fatigue Research Board, London, pp. 18-23.

†Journal of the American Society of Heating and Ventilating Engineers, January, 1925, p. 66.

mum degree of comfort is experienced by normally clothed individuals when the effective temperature is 66° F. This temperature, of course, can be produced by various combinations of dry bulb temperature, humidity, and air velocity; but for purposes of argument we may take a dry bulb temperature of 71°, and a relative humidity of 50% for normally clothed and slightly active individuals exposed to an air velocity of 50 ft. per minute (the approximate velocity in Lancashire weave sheds).

Most Favorable Conditions

In the above cases the atmospheric conditions which are most suitable for the yarn are clearly undesirable from the standpoint of the weaver, and, although yarn breakages become less numerous as the temperature and humidity rise, the ability of the weaver to repair these breakages is impaired. As a result, a point is reached when the latter factor more than neutralizes the effect of the former, and weaving efficiency begins to decrease. In the investigation previously mentioned, the point corresponded to a temperature of 72.5 to 75° at a relative humidity of 75 to 80%.

It would appear, therefore, that in the case in question, maximum efficiency will only be obtained when the atmosphere surrounding the yarn has a humidity of 85 to 87.5%, and a temperature of 82.5 to 85°, while the weaver is exposed to air having a humidity of 50% and temperature of 71° (or the equivalent of these in effective temperature). Whether the atmosphere is humidified by water-spray or steam will make no difference, since either method must be capable of giving the requisite temperature and humidity for working the yarn most advantageously. The question is whether these conditions can be maintained and their effects upon the operatives ameliorated to such an extent that the conditions become equivalent to an effective temperature of 66°.

To obtain some information on this question, a number of fans were installed in a Lancashire weave shed and the average air velocity in the vicinity of the weavers was found to be 147 ft. per minute, but, since the fans gyrated, the velocity in their path must have been more than double this amount. At high temperatures and humidities (e. g., 77.5° and 85%), an increase in the rate of air movement from 50 to 150 ft. per minute only reduced the effective temperature 1.6°, and a velocity of 500 ft. per minute only effected a reduction of 6°. Thus the possibilities connected with increased air movement are very limited, although it must be remembered that a variable air current is more stimulating than one of constant force and direction (as used in the determination of effective temperatures).

Humidity and Breakage

The superiority of water-spray over steam as a means of humidification will depend upon the temperature considered necessary for efficient weaving. If the number of warp breakages is unaffected by temperature, then water-spray will give the desired humidity at a much lower temperature than would be possible with steam. In the Lancashire investigation, however, the effect of temperature on warp breakages, although much less than that of humidity, was by no means negligible, since for a given humidity (75 to 80%) breakages continued to decrease until a temperature of 82.5 to 85° was attained.

According to Mr. Thompson, the yarn used in the American industry appears to be comparatively unaffected by temperature, consequently manufacturers can aim at low temperatures and high humidities. Thus, suitable atmospheric conditions might be provided by a temperature of 70° and a relative humidity of 85%—equivalent to an effective temperature of 68° at an air velocity of 50 ft. per minute. By evaporating sufficient water and by arranging for the necessary number of air changes, such conditions could presumably be obtained, and the cooling effect so produced would be greater than that effected by ordinary fans.

Some of the Lancashire sheds are, of course, humidified by means of water-spray, but the results of an investigation‡ in which steam jets and atomized water were used during alternate weeks in the same sheds showed that the difference in favor of water humidification was only 6.7° and 4.3° in the two sheds tested. The amount of water evaporated was not stated, and, since the custom in Lancashire is to keep all windows and doors closed, the air would probably remain practically unchanged.

Fans Necessary

These results are, however, representative of the effectiveness of water-spray installations as fitted in Lancashire sheds, and suggest that considerable modifications in the apparatus will be necessary before the inside temperature during the hot summer period can be reduced to 70°. If the American installations are capable of such an achievement, then fans are clearly unnecessary; but in Lancashire the cooling effect of water-spray should certainly be supplemented by fans.

Mr. Thompson's argument appears to be perfectly correct as far as it goes, but will water-sprays during the summer period provide an atmosphere which is conductive to the minimum number of yarn breakages and at the same time give conditions which promote maximum activity on the part of the operatives?

Incidentally, it may be mentioned that effective temperature,

‡Second report of the Departmental Committee on humidity and ventilation in cotton weaving sheds. Cd. 5566, p. 39.

as determined by American engineers, is based upon sensations of warmth, which is not necessarily synonymous with activity or efficiency; and the method adopted, although allowing for a certain amount of acclimatization, cannot be applied without modification to weavers exposed to high temperatures and humidities during the greater part of the day, and consequently acclimatized (within limits) to such conditions.

ELIMINATING SPOTS AND STAINS FROM TEXTILE MATERIALS

By Herbert C. Roberts

Spots and stains are probably the cause of more second-quality merchandise which must be sold at a loss than any other single factor. A piece which is off shade, over weight, under weight, too harsh, or too soft can be utilized if kept intact and not mixed with others, to make a salable garment. On the other hand, a piece of cloth containing a spot or stain is worthless in the affected area, and seldom does an allowance of an eighth of a yard provide a means of cutting a garment so the spot will not show.

The old saying "an ounce of prevention is worth more than a pound of cure" is certainly true with respect to spots and stains; nevertheless, the manufacturer must apply both preventive and curative measures, if his finished goods are to be free from these defects. A few typical spots and stains will be described and illustrated. Both preventive and curative measures will be outlined for these cases, with the thought that others will avoid them as far as possible or be able to remove them before serious damage has been caused.

A mill equipped to make white blankets and flannels had a steady run for nearly two years, making the styles and weights from the same stocks. No changes in the source of any of the supplies such as wool-oil, soap, or alkali had been made. It was noticed suddenly that the filling had a brownish yellow cast after steaming. The discoloration could not be removed in the scouring or bleaching. There was nothing noticeable about the yarn before steaming.

This led the management to believe that some change must have been made by the manufacturer in the composition of the wool-oil which would cause it to react with steam and oxidize to a dark color on the stock.

Samples of the oil and yarn were sent to a chemist for his analysis and recommendation. The chemist reported that he could find nothing the matter with the oil, but that the yarn showed the presence of considerable iron. He advised a systematic search to find the source of the iron contamination. He also advised that all goods in process showing this brownish

cast due to iron could be salvaged by treating the finished material with oxalic acid. The goods should be placed in a washer, and 2% oxalic acid solution (2 lb. to 12 gal. of water) added until the folds of the cloth are just covered. The bath should be heated to 180° F. and the fabric worked for ½ hr., or until the yellow cast disappears from the goods. The goods should then be thoroughly rinsed with hot water and finally with cold water until no acid reaction is obtained with litmus paper (turning blue paper red).

A systematic investigation of the various processes through which the yarn passed showed that the iron stains were coming from the steamer. This was a home-made machine, fashioned from an iron tank which had a rounded bottom. A box with perforated bottom and sides served as a holder for the filling bobbins. Steam was supplied by an open pipe, entering the bottom of the tank.

This iron tank had at all times about 3 in. of water in it. When the steam was turned on, the pressure caused this rusty water to be shot up through the perforations in the yarn holder and splash on the yarn, depositing a rusty iron stain.

Trouble from this source was eliminated by making another hole in the bottom of the tank and threading a short nipple and valve into the hole. This provided a means of draining off any condensed steam. A further precaution was taken to prevent the steam rushing into the tank and up through into the goods, by placing a "T" in a horizontal position, at the end of the steam pipe. This divided the force of the steam and sent it out sideways, and there was very little danger of any matter present coming in contact with the filling bobbins.

Stains from the Picker Room

Iron stains are very common in all branches of the textile industry, yet sometimes are not easily recognized. They are the most conspicuous in white and light colored goods. Their source or cause is very often difficult to locate.

The recent experience of a knitting mill making stock-mixture overcoatings serves as an excellent example to show how iron stains from an unusual cause can be detected and located by the application of chemical knowledge and resourcefulness.

The card tender noticed when he drew stock from a bin, one Monday morning, a peculiar reddish brown stain in the white wool of an oxford blend. This stain was all through the stock and was not the familiar yellow stain sometimes found in wool. The blend was one that had been laid down Saturday; part had been blown from the mixing room Saturday, while the remainder was run through the mixing picker, oiled, and blown to the card room the following Monday. It was the customary practice of this mill to lay down a blend of

about 1,500 lb. to 2,000 lb. This was run through the mixing picker, equipped with a Bramwell feed and a spraying device, thence into a gauze room. After the entire lot had been run into the gauze room, it was removed and run through the mixing picker a second and third time. The wool-oil emulsion was sprayed on the stock during the first and second passages, but not the third. After the final passage the stock was blown from the gauze room to the bins in the card room located on the third floor. Noon-time Saturday, would frequently find a lot which had been run through the picker twice and left in the gauze room over the week end. When this was the case, the mixing picker was shut down after the last of the stock was placed in the hopper.

The mill chemist analyzed the stains and found them to be iron stains. Inasmuch as the stains were first noticed in the raw stock, the cause could, obviously, not be caused in the dyeing or wet finishing. A check-up of the stocks used in this blend showed that part of the bale of white wool remained in the stock-house. This was carefully gone over and found to be free from any stains. An analysis showed it to be free from iron. This meant that the stain was caused somewhere between the mixing room and the card room.

The water used to make the emulsion and the wool-oil were each examined. The wool-oil was free from iron and the water showed only the normal iron content (1 p.p.m.), which certainly could cause no trouble.

Rusty Mixing Picker

The mixing picker was then examined and the pins and teeth were found to be rusty, many of them showing signs of being pitted. A lock of rusty wool was found embedded in the picker. Further investigation brought out the fact that the knitter had been complaining about the yarn being too dry to knit perfectly. The man in charge of the picker room did not wish to increase the amount of wool-oil, nor did he feel that increasing the water in the emulsion would do any good. He felt any radical change might change the weights of the roping in the card room. He had learned that glycerin had the property of picking up and holding moisture, and had added 1 gal. of glycerin to each 100 gal. of emulsion in his mixing tank. No one had been advised of this change, but the knitter found his yarn knit better on the machines. He had overlooked the fact that the glycerin would hold moisture in the stock left in the picker over the week-end and after a short time this would be sufficient to wash or wipe off all the oil that had been embedded in the metal pores of the picker-pins. The reaction of the glycerin and water had caused the pins to rust, and this rust rubbed off on the stock, causing the damage.

The black shade of this oxford blend had been dyed with

logwood. Therefore a treatment with oxalic acid could not be used to remove the stain unless all the white had been picked out and treated separately. This stock had to be set aside and worked off in blends where it would not show.

Tender Bleached Goods

Lubricating oil if allowed to remain in woolen goods, will ruin wool which is subsequently given a peroxide bleach. A knit hat had been fulled, scoured, and bleached with peroxide. The firm making these hats has had a long run on them, but all of the previous hats had been dyed in dark shades. In order to increase sales, it was decided to introduce a line of white and light colored numbers. Serious trouble occurred during the process.

After finishing, it was noticed that many hats had little brown stains and quite a few were full of little holes, resembling moth holes or holes such as are caused by dropping hot pipe ashes on the goods. The cause was apparently a mystery. At first it was thought that some undissolved particles of sodium peroxide had come in contact with the goods. To be sure that this would not happen again, the bleach bath was made up in a separate container and strained through several thicknesses of cheese cloth when adding it to the bleach tub. This precaution did not eliminate the trouble, and holes occurred as frequently as ever. It was therefore concluded that the cause lay outside the bleach house; still the fact remained that no holes were visible before bleaching, but were present after bleaching.

The search started in the knitting room. A man was detailed to watch every operation and to report anything that seemed unusual and out of the ordinary. The first thing that he noticed was a large number of oil stains made in the knitting room. In asking questions about these oil stains he was told that a so-called stainless oil was used, and no more stains were being made than usual. When making the colored hats, the stains were evidently washed out and no complaints had ever been made about oil stains or spots.

Stains from Metal

Nevertheless, the investigator took several of these hats and marked the outline of these stains with a white sewing thread; these were scoured, and fulled. They were then inspected before bleaching. In looking at the hat, no spots were visible in the area bounded by the thread, but in holding the hat up to the light and looking through it, a dark black spot was seen. The cover or nap raised by fulling had covered it over, and it was scarcely seen. They were put through the bleaching process, and after drying, wherever there was a previously

outlined oil stain, there was either a hole, or a small brown spot.

It was explained that, due to the presence of small metallic particles of the worn parts of the knitting machine being carried into the cloth by the oil and not being removed during the scouring and fulling a reaction between these particles of metal and the peroxide was set up. This is termed an exothermic reaction; that is to say, heat was developed to such an extent that the wool was scorched and actually burned.

When the facts were known, future damage was prevented by changing the oil used to lubricate the knitting machines to one of a heavier body that would cling to the metal better and would not drip on the goods. A system of inspection was adopted, whereby the hats were sorted before scouring and those having oil spots were treated separately with a solvent, which would dissolve the oil and place the metallic particles in a condition where they would be washed out before the goods were bleached.

Oil Damages Worsted Yarn

When using an oxidizing bleaching method, such as a peroxide bleach, any particles of metal are oxidized as well as the impurities in the fibers. These metallic particles may be minute pieces of bearings and working parts of the machines. When the metal oxidizes, so much heat is given off in such a small area, that the liquid can not absorb it with sufficient rapidity to prevent burning of the fibers.

A worsted yarn mill recently had a sad experience which convinced them of the forcefulness and truth of this statement. A lot of knitting yarn had been bleached with peroxide, and when inspected, a number of skeins were found to have greenish to brown stains. In many places the yarn was very tender and looked as if it had been dipped in a caustic soda solution at this point.

At some stage of the manufacturing process, worn lubricating oil had dripped or was thrown from a bearing onto these skeins. It had escaped notice. Obviously a scouring formula used in scouring a yarn of this character, would not be strong enough to remove these stains. If the scouring formula did remove any of the oil it would only remove the most readily emulsifiable portions and leave the heavier bodies behind, including the carbon residue and any metallic particles.

Unfortunately when the fibers have been so completely oxidized and burned as in this case, nothing can be done to restore the yarn. It would certainly pay to examine each skein for oil stains and other imperfections before scouring and treat these separately. If many skeins appear as these did, it is probable that something is radically wrong with the grade of lubricating oil used in some bearing. Or the bearings may

be worn to such an extent that a grade of oil heavy enough to stay in the bearing would set up too much internal or fluid friction, and in this case it would be necessary to repair the bearing.

A recommended method for removing these stains prior to bleaching would be to add to the regular scouring formula a good solvent containing either pine oil, cresylic acid, or both. In most cases, the product containing cresylic acid would have a greater emulsifying action and would give a more complete removal of the lubricating-oil stain, and at the same time would not harshen or injure the yarn.

After scouring and rinsing the yarn until free from the scouring agents, the goods should be steeped in a warm oxalic acid bath to dissolve and remove the iron. A practical working formula would consist of using 1% oxalic acid based on the weight of the yarn; a short bath (1 to 10 ratio) will prove most satisfactory. The temperature should be held at 110° F. to 130° F. for ½ hr., or until the stains have disappeared. The goods are then rinsed free from acid and leached in the regular manner.

Streaks in Silk Goods

In the manufacturing of silk fabrics, such as crepes, many stains occur which impair the value of the merchandise. The determination of the cause is many times exceedingly difficult, and likewise, the question of whether they can be removed is very problematical.

Blackened filling stains are very common. They may vary in length from almost a speck, up to two or three inches in length. In this case the stains are scattered over the entire width of the fabric and do not come in the same place or beneath each other in any pattern. These are caused by blackened filling.

Filling may be soiled at different stages of manufacturing, and the operation in which the stain is produced largely determines the ease with which it can be removed in the boil-off. Given a piece of finished fabric, it is impossible to determine at what operation the stain was caused and likewise it is almost impossible to tell from an examination of the grege goods. To visualize this impossibility, one has only to trace a quill filling from the raw silk to the shuttle and note the operations where a stain can be produced. If it were possible to tell exactly where the stain was made, a method of treatment could be prescribed which would be practically certain to remove the stain in the boil-off.

The first operation is the soaking. The only way a dark stain which defies removal, can be produced in the soaking is the use of an incorrect tint, the misuse of a good tint, or the use of the wrong type or amount of a soaking oil. The regular throwsters tints are very fugitive colors. They are readily

destroyed or removed by hot alkalies and soap solutions. If the tint is purchased from a reliable source, the danger from the use of a tint that is not fugitive is practically nil.

Use of Tints

A good tint, if not used properly, will produce a stain that is exceedingly difficult to remove in the degumming. If too large a quantity is employed or if the tint is not thoroughly dissolved, it will fix itself to the silk unevenly and in great concentrations in certain portions of the fibers. It then becomes tightly twisted in the subsequent operations and requires a severe boil-off, that is to say, the use of excessive amounts of degumming material, to say nothing of a longer time for the boil-off operation. This may be so severe in some cases, that the fibers may be broken or chafed before the last trace of the tint is removed.

In order to determine whether a stain in the filling is caused by incomplete removal of the tint, it is first necessary to degum a small sample in the usual manner. It is then boiled in a small quantity of dyestuff-stripper, such as hydrosulphite or sulphoxylate. For a laboratory test a gram of one of these products dissolved in 500 c.c. of water and brought to a boil is used. The swatch of silk is dropped in this solution, then a few drops of acetic acid are added, and the sample boiled gently for 15 min. Should the color be destroyed, we can assume that the stain was caused by excessive use of tint, the wrong kind of tint, or some undissolved tint being twisted into the fibers. If the stain remains, we can assume that it is grease or oil.

The material used in the soaking bath may be the indirect cause of stained filling. Should the amount of soaking oil used be in excess, the soaking bath too hot or too alkaline, there is a danger of opening up the fibers or causing split fibers. These fibers are more or less separated, and lint, grease, oil, and dirt become easily attached. With each successive operation, the impurities become more tightly twisted into the thread and their removal is impossible without extra operations and increased cost. Stains of this character are almost invisible after boiling-off, and although not sufficiently removed to permit the goods to be sold as white, would be scarcely noticed in any except the lightest shades.

Filling may be soiled during the winding, twisting, or doubling, in fact any operation where yarn can become caught in a bearing, or come in contact with a greasy twister ring or bar which has been oiled too heavily, or one upon which too light a twister-ring grease has been used.

It matters little, how so-called stainless or light in color a twister-ring grease may be before it is applied to the rings. As soon as it is used, small metallic particles from the bearing become diffused through the grease, and it soon becomes

blackened. When this blackened grease becomes twisted into the yarn, it requires severe processing to remove it.

Filling which has become soiled by a weaver or loom fixer grasping a quill with dirty hands or a quill dropping on the floor, produces a blackened stain which is fairly easy to clean. The grease and dirt are not twisted into the yarn, but only adhere to the surface. The boil-off material can readily penetrate, loosen and emulsify this type of stain. A surface stain of this type stands out more and is blacker than a stain which has been twisted into the filling.

With a fabric as expensive as silk, it has been suggested that in the perching and examining, any pieces which show soiled filling-stains be treated separately, that is to say, treat the spot by rubbing it gently with gasoline, or better still, rub a good soluble-oil solvent into the piece. The pieces are then ready for the dye-house. In the boil-off the stained pieces should receive extra care in handling so that a stronger boil-off bath can be used and the pieces run a little longer. If these precautions are taken, the pieces can generally be dyed any shade and the spots and stains will not be visible.

Shuttle-marks are a frequent cause of second-quality goods. A serious difficulty with shuttle marks is that many times they are not perceptible to the naked eye during the weaving or during the inspection in the cloth room, but stick out like a sore thumb after the pieces are finished.

The most common causes of shuttle marks are the shuttle pressing the filling against the front part of the box just as the shuttle is leaving, and filling being rolled under the shuttle as it leaves the box. Most shuttle marks appear in perpendicular rows, like a column of figures, $\frac{1}{4}$ to $\frac{1}{2}$ in. wide. When caused by the shuttle pressing the filling against the front part of the box, the shuttle mark is much longer than the marks caused by the filling rolling under the shuttle.

Moisture condensing on the shuttle will cause it to become sticky and allow it to collect dirt and lint. The least little misalignment or improper timing which will allow the filling to get out of control or the shuttle to be misguided, will cause the shuttle to mark the filling.

Many devices such as tying a piece of cloth around the front of the shuttle box and changing this as soon as it becomes soiled, are effective in preventing shuttle marks. Individual types of looms can be adjusted in different ways. For example, those looms with a binder in front of the shuttle box are adjusted to eliminate shuttle marks by changing the rocker foot so that the push of the picker, from the beginning to the end will be toward the front of the box. Since the rear of the shuttle is always in contact with the picker, this adjustment will have a tendency to force the front end of the shuttle toward the reed, and the pressing of the filling against the shuttle box is avoided.

In the case of the drop-box loom, the adjustment is more simple. In this type loom, the picker is guided by a spindle and not the picker stick. The spindle can be adjusted so as to guide the front of the shuttle toward the reed. This will prevent the shuttle from pressing the filling against the front side of the box.

HORIZONTAL-BELT CALCULATIONS

New Chart Assists Determination Of Tension and Power Transmitted

By W. F. Schaphorst

Every belt user knows or should know that no such thing exists as a perfectly horizontal power-transmission belt. No matter how great the load that is being transmitted, there is always a sag in the "tight" side of the belt as well as in the "slack" side. It is impossible to make the pull so great that the tight side will be perfectly horizontal or perfectly straight. Sag cannot be eliminated without external support of some kind. Power-transmission belts are seldom supported.

Finding Tension

These facts paved the way to the production of the chart shown in Fig. 1 which now enables anyone to compute the tensions in any horizontal drive when the span and sag are known. Measure the sag (Fig. 2) in inches and locate it in Column A. Measure the span in feet and locate it in Column B. Then run in straight line through the sag, Column A, and the span, Column B, and the intersection with Column C gives the tension in the belt in pounds per square inch.

For example, if the sag is 6 in. and the span is 20 ft., the tension as shown by the dotted line drawn across the chart is 42 lb. per sq.in.

Fig. 2 shows where the sag should be measured—at the point where the sag is greatest. Thus, if both pulleys are equal in diameter and the drive is truly horizontal, the sag would be measured at the exact center. If the drive is not truly horizontal, and if one pulley is larger than the other, the results obtained by the use of this chart may not be 100% correct, but they will be close enough for an approximation.

The beauty of this chart is that it is applicable to the tight side of the belt as well as to the slack side. Thus, if the sag is only 1 in. on the tight side and the span is 20 ft., a straight line through the 1, Column A, and the 20, Column B, shows that the tension in the tight side is 250 lb. per sq.in.

Power Transmitted

Every belt user knows that the sag on both sides varies with the load. The greater the load, the less the sag on the tight side and the more the sag on the slack side. Therefore, know-

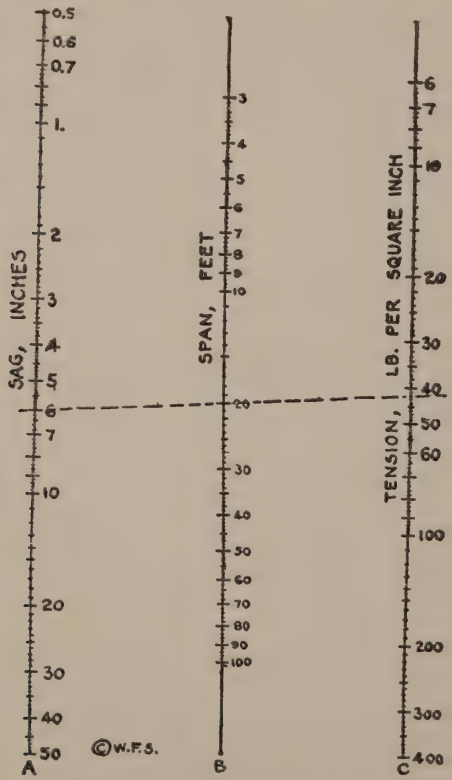


Fig. 1. Chart for Computing Tension in Horizontal Belts

ing these things it further develops that the power being transmitted by many horizontal drives can be computed by the use of this chart. If the sag and span can be measured, the rest is easy.

One can usually measure sag and span with an ordinary yardstick. Four other measurements are then necessary—the width and thickness of the belt, the outside diameter of one of the pulleys, and the r.p.m. per minute of that same pulley. These measurements may all be taken with the same yardstick and with an ordinary watch.

In measuring the span, please note that it is not the distance from center to center of the shaft, but is the distance between the points where the belt leaves one pulley and touches the other. Measure the sag of the slack side from these points, which might be called the "points of tangency" or "points of touching."

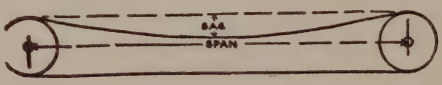


Fig. 2. Where Sag Is Measured

The span and sag of the tight side should then be measured again observing the points of "making and breaking contact" as just explained.

Then, referring to the chart, find the tension corresponding to the span and sag of slack side, which we will call *A*. Next find the tension corresponding to the span and sag of the tight side, which we will call *B*. Subtract *A* from *B*. Multiply by the width of the belt in inches. Multiply by the thickness of the belt in inches. Multiply by the outside diameter of one of the pulleys in inches. Multiply by the r.p.m. made by that same pulley. Multiply by .000007933. The answer is the horsepower being transmitted by the belt at the time of measurement.

Without the Chart

For those who might prefer to make all computations first hand, without using the chart, I shall give the rule for measuring the tension of the belt in pounds per square inch. The rule is as follows: Square the span in feet, divide by eight, divide by the sag measured in feet, and multiply by the weight of the material used in the belting contained in a piece 1 ft. long by 1 sq.in. in section.

For oak-tanned leather belting, on which this chart is based, the weight of a piece 1 ft. long by 1 sq.in. in section is 0.42; for mineral-tan leather belting, 0.36; for rubber belting, 0.54; and for hair belting, 0.42. Canvas belting varies from 0.312 to 0.6.

ANALYSIS OF UNION TEXTILE MATERIALS CONTAINING VARIOUS FIBERS

Finding Foreign Matter and Wool, Hair, Silk, Cotton, Linen, and Rayon Content

The accompanying article is a reply to the following inquiry, recently received by our Questions and Answers Department:

Will you kindly inform the writer if there is any known chemical test to determine the rayon and cotton percentages of a fabric? Take a mixture of 50% wool, 30% rayon, and 20% cotton; is there a test to determine these three stocks, or can we simply find by boiling that there is 50% wool and 50% vegetable fiber? A recent criticism of a fabric led the writer to believe that there might be such a test, but it hardly seems probable. Of course each fiber might be examined with a microscope, but I want to know whether there is a quick commercial test without examining each fiber. (6715)

For a reasonable, accurate and complete analysis of union textile material containing animal fibers (wools, hairs, silks), vegetable cellulose fibers (cottons, linens), and rayons (acetate or regenerated cellulose groups), the following tests should be applied:

(A) For "foreign matters" in the sample:
1. Moisture
2. Oils, fats, or waxes (lubricants)
3. Sizing, finishing, or coloring matters (if shown to be present by qualitative tests)

(B) For purified, bone-dry textile fiber content:
4. For groups of rayons present, and amount of acetate rayon
5. Animal fiber (wool)
6. Regenerated cellulose rayons
7. Vegetable fiber (cotton)

Moisture.—Moisture represents the weight loss of the weighed sample when bone-dried to constant weight in a hot air (conditioning) oven, provided with a good circulation of dry air, at a temperature of 110° C. (220° F.).

To determine moisture, weigh the samples when in moisture equilibrium with the given atmosphere. Dry thoroughly in the oven. If conditioning oven is not provided with an analytical balance for weighing in the hot oven, cool the samples in a completely dried atmosphere and reweigh while protected from moisture. Compute the loss in weight to a percentage basis on the air-dried weight of fabric started with. One hundred

per cent minus this gives the per cent of bone-dry foreign matter and textile material in the sample.

Moisture is a necessary but very variable component of textile materials. Its quantity is dependent upon:

(a) The kinds of fibers present and their chemical condition (raw, scoured, bleached, mercerized).

(b) The kinds, amounts, and distribution of foreign substances (sizings, oils, waxes, deliquescents) in the sample.

(c) The temperature, circulation, and moisture state (humidity) of the surrounding air.

(d) The time and thoroughness of exposure (protected and unprotected) to a new humidity atmosphere.

This variability of moisture content makes the relative proportion of bone-dry textile fibers also a variable quantity. Also, since the conditions necessary to give a constant amount of moisture in a fabric are difficult to maintain, its quantity must not only be determined, but care must be taken in the selection and weighing of samples to prevent errors in analysis through any undesired gains or losses of moisture at or between the times of weighing. Precautions against such sources of error include:

Precautions Against Error

1. Weighing all original samples needed for all of the tests at the same sitting, or under the same humidity and temperature conditions.

2. Keeping bone-dried samples out of contact with moist air, as by running drying tests in a special conditioning oven provided with a not-oversensitive analytical balance, or by cooling and storing heated samples in a dried air (in a desiccator over fused calcium chloride or strong sulphuric acid).

3. Computing the results of an analysis to a moisture-free basis, and then to a "reconditioned" proportion by use of the commonly accepted standard regain figures for each of the types of fibers when properly conditioned. A truer moisture-content figure for the samples in the original air-dried condition may be arrived at by determining the moisture content of skeins of the respective fibers which have been brought to a moisture equilibrium with the same atmosphere as that surrounding the samples, then using these figures for computing the actual weights of fibers from their bone-dried weights.

4. Reconditioning all samples for several hours by rotating them in a standard atmosphere of 65% relative humidity at 70° F. before any weighing at the start of or during an analysis.

Foreign Matter

Foreign Matter.—Foreign matter may include:

(a) Surplus moisture over and above the standard regain values.

(b) Lubricating or softening materials (oils, fats, waxes).

(c) Sizing and finishing substances (starches, sugars, glues, vegetable gums, deliquescents, antiseptics, weighing substances).

(d) Heavy coloring or mordanting components.

(e) Dirt.

These materials, if present (as may be indicated by qualitative trials for each group) reduce the proportion of bone-dry textile fibers in the sample in a degree related to their own amounts and, further, may abnormally affect the quantity and distribution of moisture in the material.

There are two ways of proceeding with this analysis. One way is to extract the whole group quantitatively and compute the results to include it as a "loss on desizing." The second way is to remove the group qualitatively, neglect it in computation, and report the amounts of the various fiber contents only, either on a bone-dry basis on the purified textile fibers, or on a computed "reconditioned" basis. Which method employed should be clearly designated in reporting results.

Oils, fats and waxes may be extracted with warm, residue-free, organic solvents, like carbon tetrachloride or ether, in an open breaker. The sample is weighed air-dried, repeatedly extracted without loss of solvent, and the sample bone dried and reweighed; or the combined portions of solvent used may be evaporated to dryness and the dissolved residue weighed. In either case, by proper manipulation the solvent may be recovered if so desired.

Most sizing and finishing materials may be removed by repeated extractions with boiling water, including one hot treatment with ¼ to ½% hydrochloric acid (if much starch is present), followed by plain water or water made slightly alkaline with ammonia, then alcohol and ether. Bone dry and reweigh cold and dry. Weighing matter, if shown to be present by an ashing test, may be removed by a preliminary boil in 1% soda ash solution, using mechanical rubbing if needed, followed by the boil-off treatment previously described. Some analysts allow 2 or 3% correction of cloth residue for fiber loss in this treatment. The loss is computed to a per cent basis (air dried) and called "loss on desizing" or "foreign matter." The results now show per cent of moisture, per cent of foreign matter, and per cent textile matter on air-dried basis; or they show per cent foreign matter and per cent textiles on bone-dry basis.

Components of Fiber Group

Textile Materials.—With a knowledge of the per cent moisture, per cent loss on desizing, and per cent of bone-dry fiber in the sample, the next step is to determine the components of the fiber group. The types of tests to use and their order of application vary with the kinds of rayon present, notably with the presence or absence of acetate yarns. This type of rayon is seriously affected by alkalies, is soluble in acetone, and has a low content of moisture (6.5%). The regenerated cellulose rayons are variously, but not so seriously, affected in weight by dilute caustic alkali (viscose, cuprammonium, and nitro).

It is advisable to run special tests with standard samples of these to establish their correction factors for the particular brands in question in the analysis, if known. These rayons are not soluble in acetone and have hygroscopic moisture contents at standard conditions of various values from 11 to 14% (but are commonly averaged at 11% by agreement). In order, therefore, to know what tests and what correction factors to apply, it is very necessary to know the type of rayon being dealt with.

The analysis of the purified textile fiber consists in determining:

(a) Cellulose acetate, then wool, leaving the cotton (if cellulose acetate has been found), or

(b) Wool, then rayon, leaving the cotton (if no cellulose acetate is present).

In either case proper correction for the action of the solvents causing loss in weight from the undissolved fibers must be made.

Methods of Procedure

To determine group of rayon present, boil a bit of the sample in acetone (held in a small container immersed in hot water or heated by steam or a non-arcing electric stove; avoid free flames). Boiling strong acetic acid may also be used. After solution is complete, evaporate the acetone to dryness or highly dilute the acetic acid solution with cold water. The film residue from the evaporated solution in acetone, or the readily formed, bulky, stringy precipitate obtained from the water dilution of the acetic acid solution, indicate the presence of rayon. No residue or no gelatinization of the sample on treatment with acetone, or no precipitate indicate absence of acetate rayon.

To determine the quantity of acetate rayon, repeatedly extract a weighed sample with warm acetone in an open container (not a soxhlet extractor) until extraction is complete, as shown by absence of residue on evaporating a bit of the last portion of acetone used. The combined portions of solution may be evaporated to bone-dryness and film weighed. Or the cloth may be bone dried and reweighed cold if the quantity of acetate rayon is appreciable. The loss in weight of fabric sample may

include moisture, oil, or acetate rayon, according to the kind or previous treatment of sample used, and this per cent of loss must be corrected for these components. It may be best to figure corrected bone-dry residue on bone-dry sample (on original or on purified textile material). There is no correction to be applied to the residual fibers for the acetone action. There would be for the use of boiling acetic acid. Its magnitude would have to be determined.

Wool Determination

The determination of the wool quantity may be done in two ways: by dissolving it in 2 to 10% caustic soda solution at a boil, or by dissolving the vegetable fibers in cold 36° Bé. sulphuric acid, leaving the wool (apply correction for loss suffered by wool).

To use the first method, boil a proper sample for one-quarter hour in a good volume of 2% caustic soda (use 10% if silk is present). The sample should not contain acetate rayon. The other components, moisture, and foreign matter, can be corrected. After boiling, filter the residual fibers through a 100 mesh brass sieve, wash thoroughly in water, acidify with acetic acid, wash free of acid with water, rinse in acetone, and bone dry the residue, then weigh. The correction of this weighted residue for loss suffered through the action of the caustic soda depends upon the type of rayon present and its relative amount to the cotton present. If the residue is largely cotton, as determined by later tests, add 5% of its weight to itself and call the corrected residue the amount of vegetable fiber. If the residue is largely viscose or cuprammonium rayon, correct by 4%, and if largely nitro rayon use 8%. If about an equal mixture of cotton and either of these rayons, correct accordingly when using short-cut computations.

Compute the percentage of the corrected residue on a bone-dry basis. It represents cotton and regenerated cellulose rayons. Add to this percentage the percentage of foreign matter and that of acetate rayon (both on bone-dry basis), and subtract their sum from 100. The difference represents the percentage of bone-dry wool.

The rayon may now be separated from the cotton by dissolving it out in either of two ways by close adherence to established conditions:

(a) Stir the dry sample into concentrated hydrochloric acid at 120° F. for 3 min. Remove sample, wash thoroughly in water, neutralize with dilute ammonia, wash again with water, bone dry, and weigh. The bone-dry residue is cotton. It has suffered a weight loss of 6½%. Add this amount, therefore, to the bone-dry weight for raw cotton (5½% if cotton is bleached and mercerized).

(b) Or stir dry sample into 5% chromic acid solution at 120° F. for five minutes. Wash thoroughly in water, bone dry, and weigh. Increase the weight of bone-dry residue by about 4% as a correction factor.

This corrected cotton weight is now used in two ways: First subtract it from the weight of uncorrected, mixed, bone-dry residue left after the wool extraction. The result gives the weight of rayon in this same residue, uncorrected for its own loss due to its solubility in the caustic soda used for taking out the wool. Second, the corrected cotton weight previously mentioned is again corrected for its loss due to caustic action by adding 5% of itself. This finally corrected cotton weight is the amount of cotton present in the bone-dry textile sample started with.

To take up the weight of rayon where left in the above paragraph for more accurate calculation and to correct it for its loss of weight due to caustic action, add the following percentages according to whether it is a viscose, cuprammonium, or nitro rayon—3, 4, or 8%. This corrected figure gives the amount of bone-dry rayon other than acetate rayon, in the original bone-dry sample.

Amount of Bone-Dry Wool

Now to find the amount of bone-dry wool in the original bone-dry sample, add the percentages (on the bone-dry basis) of foreign matter, acetate rayon, regenerated cellulose rayon, and cotton. Subtract their sum from 100. This completes the computation of the sample accurately on a bone-dry basis.

Commercial fibers consist of the bone-dry fiber plus the standard amount of regain moisture. To compute the per cent composition of the purified textile fiber sample on a "conditioned" basis, add to the bone-dry weight of acetate rayon 6.5% of itself; wool, 16% of itself; regenerated cellulose rayon, 11% of itself; raw cotton, 8% of itself; and bleached cotton, 6.5% of itself. Add together these corrected weights and compute the percentage of each corrected weight, using this new sum for the purified fiber sample. Or add to each fiber weight the proper amount of moisture as found from the standard skeins of each fiber, and figure the result as the per cent fiber composition for the original fabric under the given atmospheric conditions at the time of analysis. The difference between this and 100% will be due to surplus moisture, oil, and sizing in the original fabric.